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## ENGINEERING NEWS.

THE NET EARNINGS OF 107 RAILWAYS for February and of 105 railways for the first two months of this year, according to statistics collected by *Bradstreet's*, show as follows compared with the same periods of last year:

| | 1890 | 1889 | Inc. per cent. |
|---|---|---|---|
| **FEBRUARY.** | | | |
| Gross | $41,509,433 | $38,040,662 | 9.1 |
| Net | $11,226,617 | $10,686,518 | 5.0 |
| **TWO MONTHS.** | | | |
| Gross | $84,374,527 | $77,774,736 | 8.4 |
| Net | $23,435,110 | $21,423,300 | 9.3 |

The detailed list shows that the decrease in earnings of the coal and Pacific roads is mainly responsible for this rather poor showing. All the other groups show large increases. The Southwestern roads take the lead with a gain of 39 per cent. followed by the Central Western, Granger, and Trunk lines, with gains of 18, 10.2 and 8.9 respectively.

THE VALUE OF AN ARCHITECT'S PLANS having been the subject of controversy between an insurance company and an architect whose plans were destroyed by fire, Mr. A. J. BLOOR, architect, of New York, was called in as a referee. The lost plans were described as sketches for a proposed hotel to cost $400,000, and these documents were valued at 1 per cent. on the estimated cost of the structure, according to the customary schedule charge of architects. Mr. BLOOR believes that as the courts agree that this 1 per cent. is a proper and customary charge for the professional labor involved in the production of these plans, that the charge was valid. But from the standpoint of an average judge and jury, he feels that he must also take into account the fact that this one per cent. includes the mental conception on the part of the designer, and that this conception still remains to the loser by fire. The reproduction of lost plans by memory is, of course, an irksome and troublesome task; and in many cases the designer would prefer to elaborate the whole scheme *de novo*, without reference to any antecedent processes. But, from a purely legal standpoint, this memory remains to the architect as stock left after the fire, and Mr. BLOOR therefore recommends that $1,000 be deducted from $4,000 first mentioned.

THE U. S. GEOLOGICAL SURVEY, through its Director, Mr. J. W. POWELL, asks Congress for an appropriation of $800,000 for the ensuing year. Nearly all of this is to be used in surveys for irrigation purposes; the average being about $40,000 for each of the far Western States, except California and Texas for which $60,000 is asked for each. The maps for the surveys of 1888, for Montana, Colorado, New Mexico, Idaho, Utah, Arizona, Nevada and California, will be ready for the engravers by July 1. They will cost $50,000.

OFFICERS' MEETINGS have been inaugurated by General Manager J. P. ODELL, of the Baltimore & Ohio. The officials of the different divisions are called together as opportunity arises, and matters of technical interest, such as standards, methods of organization, rules, appliances, etc., are discussed. An interesting meeting was held on April 15, at which nearly all the general and division officers were present.

General rules governing the employés and defining their duties were discussed, and papers were read by Superintendent T. FITZGERALD on "Transportation," and by Division Engineer of Maintenance of Way W. T. MANNING on "Maintenance of Way." Reports were also made by committees appointed at a previous meeting on "Signals," "Rail Joints" and "Oil."

One of the greatest stumbling blocks in the way of efficient and economical railway operation is often the lack of harmony between different departments. Meetings like the above, in which the different heads become familiar with each other's work, should do much to remedy this.

A FAST RUN on the New York Central & Hudson River R. R. is mentioned in the Poughkeepsie *Eagle* as having occurred between Albany and Poughkeepsie, N. Y., on April 12. The train was composed of an engine, a Michigan Central baggage car, one buffet car, dining car, two passenger cars, one drawing-room car and two sleeping cars. On the way over the bridge at Albany the cylinder head of the engine was blown out, delaying the train at East Albany a little over 40 mins. till another engine could be procured—engine No. 711, of the middle division. At 5:34 P. M. the train started again. It ran from East Albany to Hudson (28 miles) in 30 mins., arriving there at 6:05 P. M., and left at 6:10 P. M. It passed Tivoli (49 miles) at 6:29 P. M., Barrytown, at 6:33 P. M., Rhinebeck (54 miles) 6:40 P. M., and reached Poughkeepsie at 6:55 P. M., thus making the 70 miles with 8 cars in 1 h. 20 mins., having run from Rhinebeck to Poughkeepsie (16 miles) in 15 mins.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment April 14 on the Little Miami R. R. at Rendcomb, 8 miles from Cincinnati, O. A misplaced switch and an unlighted switch lamp led to the derailment of a heavy freight train. The engine was overturned and 8 freight cars were wrecked, blocking the road for some time. No lives were lost. Another misplaced switch accident occurred April 21 at Hibbard, Ill., on the St. Louis, Arkansas & Texas R. R. Four cars of a passenger train were overturned, and 6 persons were injured.

BRIDGE ACCIDENTS are reported as follows: A derailed truck of a freight car bunched the ties on the Sugar Creek bridge of the Louisville, New Albany & Chicago R. R., near Crawfordsville, Ind., on April 17; 10 cars were wrecked. The truck had been derailed a quarter of a mile from the bridge, and a re-railing device would very likely have prevented the accident.——The new iron bridge over the Black River, at Poplar Bluffs, Mo., gave way April 13, the floods having damaged the middle pier.——The footway of the Limestone St. bridge over Buck Creek, at Springfield, O., gave way April 20 under the weight of a crowd of people who were watching a baptism. The bridge was condemned two years ago, and had been repaired, but not properly, so it is said.——The Great Northern Ry. bridge across Beaver Creek, near Ashfield, Mont., was burned April 16. It was 240 ft. long, having one span of 80 ft. and the rest being trestlework.——About 75 ft. of the trestle carrying the Cape Fear & Yadkin Valley R. R. across Reedy Fork Creek, 10 miles from Greensboro, N. C., were burned April 16.——The Prairie Creek trestle of the Cleveland, Cincinnati, Chicago & St. Louis R. R., near Tremont, Ill., was destroyed by fire April 15.

THE MISSISSIPPI FLOOD is now doing its worst in Louisiana. On April 22 a number of breaks in the water-soaked levees occurred near Bayou Sara, including the high Morgansea levee. Much loss of property and probable loss of life will follow these latest breaks. The town of Bayou Sara is said to be in ruins. Gov. NICHOLS, of Louisiana, has considered this latest disaster of sufficient importance to appeal for Government aid through U. S. Senator GIBSON.

A LEVEE CONVENTION is to be held in Vicksburg on April 30 to generally discuss the situation developed by the existing floods. It is shown by the report of the United States Bureau of Statistics that up to 1887 the actual loss from overflow, without any theoretical estimates, was $200,000,000.

AN ACCIDENT ON AN ELECTRIC RAILWAY occurred April 11 at Tacoma, Wash. A car became unmanageable and ran away on a steep grade; at the bottom it jumped the track and ran into soft ground, where it stopped. Nobody on the car was injured, but two persons who jumped off were bruised and cut by the fall. The iron brake-bar, 2 × ⅝ ins., broke, and let off the brakes; the driver then reversed the current, but the strain stripped the cogs from the gearing, and there was then no control over the car.

THE SOUND STEAMER *Puritan* was docked this week, and it was found that the injury received by running on the rocks above Hell Gate was more serious than supposed. A ragged hole about 100 ft. long and several feet wide in parts is found in her outer hull. The double hull alone saved her from sinking. It will probably take two weeks to repair the damage.

THE SAFETY OF RAILWAY EMPLOYES has been made the subject of a bill introduced in Congress by Representative FLOWER, of New York, on April 21. J. WARREN COULSTON and J. F. LOUGHREY, of Philadelphia, representing a brake and coupling company, addressed the Committee on Railways and Canals now considering this bill. They strongly urged legislation to compel the use of automatic brakes to ensure safety of life and limb and railroad employés, but took exception to that section of the bill which requires the use of automatic air brakes, on the ground that it would confine the roads to a device made by one company operating under a patent, prevent competition and development of such devices and endanger the lives of employés, as from the complexity of the device they are frequently required to go beneath and between the cars, and, in fact, to get into just such positions as the patent couplers were intended to make unnecessary.

PROGRESS ON THE HUDSON RIVER TUNNEL, to date, stands as follows: The new shield is being erected on the west side at a point 2,050 ft. from the shore end. This shield is complete up to the top girder and will probably be in working order in about ten days. On the east side the condition is not so favorable. The late attempt to pump the tunnel out developed several very large leaks in the caisson next to the shaft, and the shaft itself was badly shaken, and the timbers had separated so as to cause extensive leaks. These leaks have now been plugged in the shaft; but those in the roof of the caisson are more troublesome, as this is under the wharf. Divers are now at work trying to plug them up from below. It is hardly necessary to state that the late stories of "rats with oakum tied to their tails" being chased into the cracks in an attempt to plug them, are simply a reporter's "fake." We believe a rat was found in one of the pulsometer pumps, but that is the sole foundation for the story.

THE DETROIT RIVER TUNNEL QUESTION is to be reported upon by a board of army engineers, composed of Col. POE and Capts. ALLEN and ADAMS. They meet in Washington, and are to report upon the practicability and estimated cost of this tunnel.

THE SAULT STE. MARIE CANAL, says W. W. CARGIL, President of the Sault Ste. Marie Water-Power Co., now has all the money required for completing the canal and developing 6,000 horse power. The merely formal work of examining titles is now going on, and the company will issue bonds for $200,000, making the total cost of the canal, including land and right of way, about $600,000. The additional expenditure of $100,000 will develop 6,000 horse power more, and the same proportion of cost will increase the power to its full estimated capacity of 30,000 horse power.

THE IMPROVEMENT OF THE SAULT AND HAY LAKE CHANNEL was reported upon favorably by the River and Harbor Committee at Washington on April 21. Certain amendments provide that the $3,738,000 appropriated for the Sault improvement shall be divided into two installments, available in two years; and the Hay Lake Channel fund into three installments. The same committee also favorably reported the bill for a deep water harbor at Galveston, to cost $6,000,000.

A BRIDGE ACROSS THE BOSPHORUS, for linking the railway systems of Europe with existing roads in Anatolia, is being discussed by the Turkish authorities. A French engineering firm is said to be pushing the enterprise. The proposed point of crossing is at Roumeli Hissar, on the European side, to Anatoli Hissar on the Asiatic side. The total length of the crossing would be about 2,624 ft.

THE BOSTON, REVERE BEACH & LYNN RAILROAD will open its passenger station on Atlantic Ave., Boston, May 1. The station combines the uses of a city terminal with those of a ferry station, and every portion of the somewhat limited area is fully utilized. The main building is of freestone with granite sills, and is two stories in height, the second being of brick and containing the railway offices. An illuminated clock occupies the central position in front. The width on Atlantic Ave. is 57 ft., depth 119 ft., with one story extensions on either side the ferry slip of 76 ft. additional. The ferry slip is of iron, 12 ft. wide by 56 ft. long, and is operated by hydraulic power. The main building is also constructed of iron columns and girders. A broad passage leads from the street directly to the boat, and there is a side passage for independent exit. The station is provided with all modern conveniences in fittings, lighting and heating.

THE DELAWARE & HUDSON CANAL CO. broke ground on Monday for a new general office building at Albany, N. Y. The cost is estimated at $150,000.

THE BALTIMORE & OHIO has offered to erect $150,000 repair shops at Cumberland, Md., and concentrate there the work now done at Martinsburg Keyser, Piedmont and Connellsville, provided the city will loan the company the money necessary to build the shops.

THE CHICAGO WORLD'S FAIR BILL passed the United States Senate on April 21, 43 yeas to 13 nays. Various amendments were discussed; but a clause calling for a naval review in New York harbor in April, 1892, was the only one passed.

A NOVEL METHOD OF SEEING THE WORLD'S FAIR, which fits it with the ideas of some people regarding the benefits to be derived, is suggested by a Wisconsin "mechanical engineer." It is proposed to arrange the buildings over and the exhibits on each side of a sunken belt railway track of 14 ft. gauge. On this track would be a continuous line of cars, provided with comfortable seats, and moving at a low rate of speed. The visitor seats himself and goes around until he has "seen it all;" or he can step off and examine things at his his leisure if he will. This moving belt is to be constructed to carry 25,000 passengers.

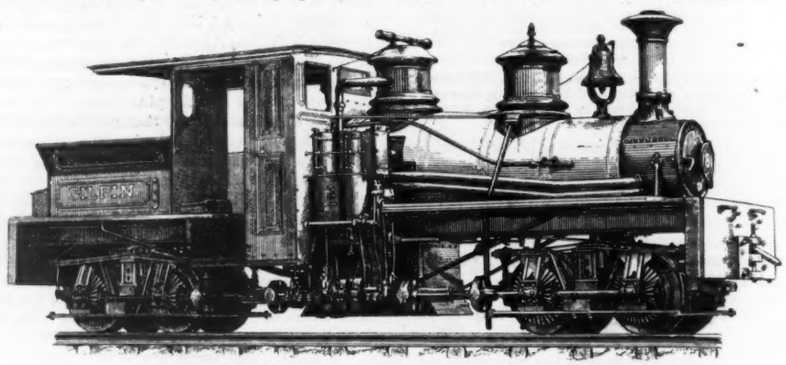
SCHMEIDBARGUSS, or letters to that effect, is getting its alleged inventor, Mr. CHARLES HARTZFELD, of Newport, Ky., into trouble. The Wheeling *Intelligencer* says that Mr. HARTZFELD has been arrested on the charge of using the mails for the purpose of defrauding. The allegation is that he is sending out long advertisements for his various companies, thus incurring obligations and refusing payment on drafts when presented. It is stated that he has defrauded several hundred newspapers in this way, in which number we must include this journal, and can certify to the fact that we never received a cent for services rendered. The general verdict is that he and his companies are frauds of a superlative degree.

AN EIFFEL TOWER OF ICE, 230 ft. high, was built at St. Petersburg the past winter. In general form the structure closely resembled its distinguished prototype, but the four legs started from the ground at a more moderate inclination. It was built of clear, transparent ice, and when illuminated by electricity made a brilliant spectacle. St. Paul and Montreal had to abandon their proposed similar structures on account of the mild winter.

## The Shay Locomotive.

The Shay locomotive is an engine of peculiar construction, having its wheels driven by gearing; it is designed for operating railways (principally mining and lumber roads) with steep grades and sharp curves. A number of these engines have been built within the past five or six years, and are in regular service.

The inventor, Mr. E. E. SHAY, of Bar Harbor, Mich., was a saw-mill owner, and transported the logs over a track laid with wooden rails. The cars were hauled by an ordinary direct-acting side-rod locomotive, which was continually jumping the track, causing delay and expense in replacing it. It was noticed, however, that the cars gave very little trouble of this kind, the two four-wheel center-bearing trucks adjusting themselves to the sharp curves and irregularities of the track, while the larger rigid wheel base of the locomotive caused the wheels to grind round the curves or jump the track. Mr. SHAY thought that if he could apply the power to a car, or have a locomotive with flexible wheelbase, he would avoid this trouble. He therefore took an ordinary flat car and fitted an upright boiler and engine upon it. A shaft was placed lengthwise of the car near the ends of the axles, and was made flexible by the use of sleeves; the wheels were driven by bevel gearing. This primitive engine proved so successful in operation, that an order was given to the Lima Machine Works, of Lima, O., to prepare plans for a locomotive of this system. One of the first of these engines, weighing 28 tons, was exhibited at the New Orleans World's Fair of 1885, and was awarded the first premium for a successful logging locomotive.



Shay Locomotive: Gilpin Tramway, Colorado.

As will be seen by the accompanying cut, the engine embodies some of the features of the Fairlie and Forney types of engines. The cylinders (two or three, according to the desired power) are vertical and inverted, as in marine engines; they are placed at one side of the boiler, near the firebox, and drive a crank shaft, which is connected by intermediate shafts and flexible connections with the short shaft on each truck. This latter shaft carries the bevel pinions, driving the bevel spur wheels, which are made in sections, and bolted to the faces of the wheels. This gearing is made of cast steel, and will wear from two to five years; when worn, new gearing can easily be fitted. It is said not to be noisy. All parts subject to wear or breakage are made of best steel and hammered iron.

The driving wheels have steel tires, if for tee-rail tracks, and extra chilled wheels if for wooden rails. The speed of the engines as ordinarily constructed is limited to 15 or 16 miles per hour, as they are geared 3 to 1 in order to give the necessary power. They can, however, be geared 2 to 1, or 1 to 1, if necessary, and will then run at 30 or 35 miles per hour; but this is not practicable for regular work. A Shay engine weighing 28 tons, geared 3 to 1, is said to have been run from Chattanooga, Tenn., to Melville, Ga., a distance of 52 miles, on the Chattanooga, Rome & Columbus R. R., at a speed of 52 miles per hour.

The principal field for these engines is in timber and mineral regions, where the railways have cheap track, sharp curves, and steep grades. One has been used, however, on a suburban line from Chattanooga to Mission Ridge; it weighed 28 tons, and would haul two loaded standard gauge passenger cars up an 8 per cent. grade about ¾ mile long. The performance was satisfactory, but the line was afterward equipped for electric traction.

The boilers of engines for roads laid with wooden track have a large and high dome over the firebox, making a boiler of ⊢ shape. The object of this is to insure a good capacity of dry steam.

The Crescent mine tramway, in Utah, built in 1884 by Brown & Brooks, engineers, of Salt Lake City, for Mr. FRANK H. DYER, of that city, is 4.793 miles long, with 0.6-mile of sidings. The grades are 222.8 ft., 276.3 ft., 322 ft., 368 ft., 414.5 ft., 460 ft., and 549 ft. per mile. The latter is 1,900 ft. long on a branch. On one of the grades of 460 ft. per mile are four curves of 50 ft. radius; the whole line is very curved. The track consists of 16-lb. rails, spliced with fish plates and two bolts, and laid on wooden ties 30 ins. apart center to center. The engine for this line has cylinders 9 ins. diameter by 8 ins. stroke, and is geared 3 to 1 on 24-in. wheels; its weight in working order is about 15 tons. It will haul 10 to 15 empty 4-wheel mining cars, weighing about 1,300 lbs. each, over the road, which rises about 2,000 ft. in 4½ miles.

A narrow-gauge line at Slate Run, Lycoming Co., Pa., owned by J. B. Weed & Co., of Binghamton, N. Y., is worked by a 25-ton, three-cylinder Shay engine, which hauls 8 to 10 cars, weighing 3½ tons each, over the line; there are grades of 8 per cent., one of which is 1¾ miles long.

The Sinnemahoning Valley R. R., which branches from the Western New York & Pennsylvania R. R. at Keating Summit, Potter County, Pa., also has one of these engines. The line is laid with 30-lb. rails, and has grades as steep as 300 to 400 ft. per mile. The engine is used mainly on branches and has given satisfaction. It has cylinders 11 × 10 ins., driving wheels 30 ins. diameter, and weighs 30 tons in working order. It will take four standard gauge cars, loaded with lumber, over a grade of 165 ft. per mile. It was found to be economical in operating expenses, but rather expensive in repairs, owing to faulty construction. It was used occasionally on passenger trains.

The engine which we illustrate was built for the Gilpin Tramway Co., of Central City, Colo., Mr. B. H. LOCKE, Manager. The road is about 12 miles long, and has a gauge of 24 ins. The country is mountainous and the curves were made very sharp to lessen the cost of construction; there were at first three curves of 66 ft. radius, but it was intended to change these to 100 ft. Ore is taken from the mines down the grades to the stamp mills, and fuel hauled up to the mines. The heaviest grades are 6 per cent., but the greater portion do not exceed 4 per cent. The track is laid with 35-lb. iron rails, spliced by fish-plates and four bolts; they are spiked to red spruce ties, 4 ft. × 4 ins. × 4 ins., and 5 ft. × 5 ins. × 5 ins., with sawed ends. The ties are spaced 2 ft. centre to centre, and the smaller ones do not allow the track to settle. By means of a third rail on the Colorado Central R. R., the company operates the branches to a number of ore mills and mines on that road.

There are two Shay engines on this line. The first one (shown in the cut) had two cylinders 7 × 7 ins., geared 2½ to 1 on 24-in. wheels. The weight was 10 tons. This first engine was built to haul a certain load up 4 per cent. grades, with curves of 50 ft. radius on the grade. The second engine had three cylinders and weighed 20 tons. Both engines were satisfactory, with the exception of some defects in construction. They passed round the sharp curves very

easily. The cars are of iron, about 16 ft. long and 4 ft. wide; some have a capacity of 4 tons, and are carried on eight 14-in. wheels; others have a capacity of 8 tons, and have eight 18-in. wheels. They weigh about 1.75 tons. The smaller engine could haul eight or ten cars up, but this load was too hard on the engine. The average train load was about 18 tons.

Over 300 Shay engines have been built by the Lima Machine Works, of Lima, O., for roads of different gauge and for different kinds of work. The Southern Equipment Co., of Chattanooga, Tenn., has the Southern agency.

## Mild Steel Made by the Thomas Process, and its Employment in Building.

The favor with which mild steel produced by the Thomas process has been received on the continent, and the peculiar adaptability of the process to our American irons, leads us to abstract the following from an article in *Glaser's Annalen* on this subject. Some of our readers may recall that the cantilever over the St. John's River, in Canada, was constructed of this material imported from Germany.

In 1888, Germany produced about 4,652,500 tons of coke pig iron, of which amount not less than 1,378,600 tons were employed in producing Thomas steel. These figures show the importance of the Thomas process in Germany and the large amount of the metal employed, although until recently its chief use was found in ship-building.

The process consists in decarbonizing pig rich in phosphorus and poor in silicon in a converter lined with a basic and lime paste; the Bessemer process works with pig rich in silicon and poor in phosphorus in a converter lined with silica. The removal of the phosphorus begins after the carbon is burnt out. A recarbonization of the metal by the addition of ferro-manganese or spiegeleisen is performed chiefly to remove the gaseous and solid oxygen compounds which are so injurious to the product. Strong recarbonization, to produce harder steel, is not advisable, both on account of the cost and because the lining of the converter would be powerfully attacked. Hence, the Thomas process is best adapted to the production of the mildest steels. These low grades, however, are little used in construction of large works.

If the endeavors to place the Thomas products on a par with those of the Bessemer converter are to meet with any success, no claims should be made that the two steels are exactly alike. Neither should the products of the basic converter and a basic hearth be considered the same. The Thomas converter is only fitted for treating irons rich in phosphorus, like those of Germany and the Southern States of this country.

The German Thomas steel (flusseisen) is an excellent quality; nevertheless all lots of the metal should be carefully tested before being used. An analysis of the products of different works resulted as follows:

| | On the Mosel. | At Ilselde. | At Peine. | At Hörde. | At Kladno. |
|---|---|---|---|---|---|
| Carbon..... | 3.00-3.50 | 3.22 | 3.38 | 3.00-3.50 | 3.50 |
| Phosphorus... | 2.00-2.25 | 2.92 | 2.72 | up to 3.0 | 2.40-2.60 |
| Manganese... | 1.80-2.00 | 2.38 | 2.00-2.50 | 2.00-2.50 | 0.40 |
| Silicon..... | 0.35-0.40 | 0.11 | 0.18 | up to 0.5 | 0.10-0 20 |
| Sulphur..... | ? | 0.05 | 0.06 | up to 0.1 | 0.02-0.05 |

In Hörde the molten pig is taken directly from the blast furnace to the converter in ladles holding about 11 tons. Sometimes the product of two blast furnaces is mixed before charging the apparatus. The charge can be kept in the ladles several hours without becoming cold. After the charge has been blown for about 10 minutes, the mass contains 0.07 per cent. C, 1.7-2 per cent P, and 0.2-0.3 per cent. Mn.

During this part of the process, only two-thirds of the requisite amount of lime is added, the remaining third is introduced about 3 minutes after the carbon flame has ceased and the liquid slag has been poured off. The metal still contains from 0.3 to 0.4 per cent. phosphorus. At the end of the blow the mass contains about 0.07 per cent. carbon, 0.05 per cent. phosphorus, 0.15-0.2 per cent manganese and 0.06 per cent. sulphur. When the slag has been again poured off and 1.5 per cent. ferro-manganese added, the metal contains from 0.15 to 0.18 per cent. carbon, 0.4 to 0.5 per cent. manganese, 0.04 per cent. sulphur and from 0.06 to 0.07 per cent. phosphorus.

In Peine, the pig iron is melted in cupola furnaces of about 11 tons capacity; at the beginning of the process, the charge contains about 3.38 per cent. carbon, 2.72 per cent. phosphorus, 0.64 per cent. manganese, 0.18 per cent. silicon, and 0.055 per cent. sulphur. After 7 or 8 minutes blowing, the decarbonization ends and the dephosphorization begins. In these works, the blow last from 10 to 11 minutes; the finished product contains 0.16 per cent. carbon, 0.54 per cent. manganese, 0.015 per cent. silicon, 0.025 per cent. sulphur and 0.06 per cent. phosphorus.

At the works in Kladno, Bohemia, the process is similar. A large amount of this basic steel has been produced in Bohemia for building highway bridges, especially large structures like the Elbe bridge near Melnik. Only one large bridge of this material is erected in Germany, the large draw at Hamburg. The Austrian government engineers have, however, adopted Martin to the exclusion of Thomas steel, on all their bridges, notably the Moldau viaduct recently finished near Cervena, illustrated in this journal last week.

In the United States the basic process has not met with much favor. It has been charged that this was due to the machinations of capitalists interested in the Bessemer process, who had bought up the patents on the basic process to suppress them, fearing its competition with the plants in which their capital is already invested. A much more plausible explanation of the non-use of the basic process in this country was given to a representative of ENGINEERING NEWS recently by a gentleman interested in the management of one of the largest steel works in the country.

At these works the basic process has been thoroughly tried, and is still in use in an open-hearth furnace. The basic converter process was discarded after a fair trial, simply because it proved more expensive to make steel in that manner than by the Bessemer process, and the quality of the steel was not enough improved to pay the extra cost.

The extra cost of making the bricks and lining the basic converter more than balanced the saving through the use of cheap grades of iron rich in phosphorus. How this comes about is easily seen. The dolomite from which the basic bricks for lining the converter are made has to be carefully assorted by hand, and every particle of sand or earth which may adhere must be removed. The making of bricks is then a long and laborious process, requiring much care and skilled labor. In Europe, where good workmen can be had for 75 cents a day, this can be done with economy; but in this country, where wages three times as high must be paid, the process is a too expensive one.

For use in the open-hearth furnace, for making a very fine grade of steel, the basic process does very well, as relining is not so frequently needed, and the bricks are more easily made than are the bricks for lining the converters. It needs a more general appreciation by engineers of the merits of open-hearth steel, however, to bring even the open-hearth basic process into extensive use in this country.

## The City of Paris Accident.

We are indebted to Mr. ROBERT GILLHAM, Member Am. Soc. C. E., and a passenger on the ship at the time, for the following interesting account of the accident to the *City of Paris*.

The steamship was built by Messrs. James and George Thomson, of Clydebank, near Glasgow, April, 1889, and was considered "as safe as human foresight can secure." The company published in book form, descriptive of their ship, their belief that they had secured in the building of the steamship "an unsinkable ship," being the largest of its kind afloat. Length 500 ft., beam 63¼ ft., depth from upper cabins to bottom of keel 59 ft., 14 water-tight bulkheads, twin screws, triple expansion engines in separate compartments, with water-tight bulkheads between engine rooms, boiler and other rooms. The appointments of the steamer in all respects were considered most complete. The boiler rooms, three in number, are each within the walls of water-tight bulkheads, the boilers arranged in each room in batteries of three. There are nine boilers in all. These were made from steel, 19 ft. long and 15½ ft. in diameter, carrying a pressure of 150 lbs. per sq. in. There are nine feed pumps and four fire pumps. The boilers deliver steam to engines through two 18-in. steam pipes.

The stroke of all engines is 5 ft. and the dimensions of cylinders are as follows:

1st cylinder, diameter, 45 ins., initial steam pressure, 148 lbs. per sq. in.

2d cylinder, diameter 71 ins., initial steam pressure 56 lbs. per sq. in.

3d cylinder, diameter, 113 ins., initial pressure 12 lbs. plus vacuum.

Port and starboard engines are alike in all details, and so made that the parts on one are interchangeable, one with the other, but operate each its own independent propeller shaft. The cylinders are all steam jacketed, the condensation being returned to the boilers.

The condensers have, each, two 20-in. outboard delivery pipes 8 ft. below water line, and two 20-in. injection openings to condensers, 18 ft. below water line. It is supposed that when the engine broke the condenser and the connections with these openings the water flooded the engine room through them. The approximate or estimated weight of the moving parts of the large cylinder of the starboard engine, which collapsed, is as follows:

Piston, 9 tons; piston rod, 5 tons; cross-head, 2½ tons; connecting rod, 7½ tons; crank and connections, 14½ tons. The propeller shafts have a diameter of 19½ ins., and are 45 ft. long; the engine shafts have a diameter of 22 ins.

The engines have frequently attained a speed of 90 revolutions per minute when Welsh coal was used in boilers, or a piston speed of 900 ft. per minute. The American coals have not given as good results, but have without much difficulty generated steam sufficient to maintain 86 revolutions per minute, or 860 ft. per minute piston speed. The engines on one occasion developed an aggregate power of 20,300 H. P.

The boilers consume usually about 300 tons of coal each day, or 500 lbs. per minute. Each battery of boilers is independent of the others, and in separate compartments, and have also independent coal bunkers. The steamer has a double bottom, so arranged that water can be pumped into the spaces between the outside and inside shell or skin as ballast, there being provision for 1,680 tons of water ballast in the spaces referred to. The steamer when loaded usually draws 20 ft. of water forward and 23 ft. aft. The water-tight compartments are arranged as follows, with no openings in the bulkheads of any kind:

First, three at bow for steerage passengers or cargo; then follow two compartments for cabin passengers, then four compartments occupied by boilers, coal bunkers, kitchen and engines; next to engine compartment follow two compartments for cabin passengers, then finally two for steerage passengers or cargo. Immediately aft of engine room is the dynamo room.

The *City of Paris* has, perhaps, the most complete hydraulic system of any steamer afloat. The cargo is loaded and unloaded by hydraulic power; the anchor is raised by it, and the ship is steered and controlled by it. This is a complete arrangement, yet in this will be shown a great weakness. This steamer had the confidence of the public, and was believed to be the safest, and so constructed that no accident could possibly occur that would disable her and leave her to the mercy of the sea. It was this feeling that made the owners say in their printed book: "So thoroughly is everything duplicated, and even triplicated in many cases, it will be next to impossible to completely disable the motive power," and caused others to refer to the spars and rigging as "the sticks and strings of the deck fiddler."

We sailed from New York Wednesday evening, March 19, in a snowstorm, and made an average speed of 450 miles per day up to five o'clock on the afternoon of Thursday, March 25, about 200 miles from the Irish coast. On the same afternoon, about four o'clock, through the kindness of Mr. WALL, the Chief Engineer, I visited with him and two other gentlemen the engine-rooms and examined the engines, pumps and machinery generally. The engines were then making 86 revolutions per minute, and under perfect control, as in explanation of the simple apparatus for cutting off steam on the engines; the steam was partly cut off of the starboard engine, which collapsed, and it immediately began to slow down to about 30 revolutions per minute, and as soon as the valve was fully opened ran immediately up to 86 revolutions per minute. Everything seemed to be in perfect work-

ing order, though the tail rod of the large starboard engine, as it came through the cylinder head, deflected at each stroke toward the starboard side, and on the down stroke returned again. There were no evidences of hot bearings, hot pins, or troublesome connections. We stood at the cylinder, at the crosshead and crank of the engine in question on the different platforms, and watched the parts carefully and discovered no signs of weakness or defects of any kind or character. We returned to deck, and had only reached the saloon when the steamer vibrated and trembled from stem to stern, as though she was riding over a rocky bottom—about the same sensation as one may experience in a railway train running at the rate of ten miles an hour over the cross ties. This continued for about ten seconds, partly ceased, and then commenced again with greater force for a number of seconds and then finally ceased. I went on deck and discovered that the port engine was still in operation and the steamer still under headway, and continued for some little time, when this engine also ceased operating. Steam in large volumes and with much noise was escaping from the starboard engine room, followed soon by escape from safety valves in boilers. I picked up packing on the deck on starboard side at engine room and fragments of various kinds. When the steam had to some extent cleared from the engine room it was discovered that the large cylinder, 113 ins. diameter, was broken to pieces and had disappeared in the water, which was then 15 ft. deep in both the starboard and port engine rooms, the columns broken away, and the eccentrics turned end up against and partly through the bulkhead between the engine rooms. Such a confused, broken mass of machinery has, perhaps, never been witnessed in marine engineering. The outside framework of the upper cabin remained intact, the damage being confined wholly to the engine room. As the steamer rolled from side to side in the heavy sea, the 18 ft. of water then in the engine room rolled over like a small tidal wave and almost hid from view the engines. The port engine was not, we think, damaged, but was under water; the first two cylinders of the starboard engines remained in position, but the third was lost to view entirely.

The water, by some means or other, began to fill the first compartment next aft of the engine room, and, through the shaft tunnel and leaks in the bulkheads, filled two other compartments in the steerage.

It is needless to give here a description of how the deck hands attempted to put a sail over the hole in the ship's bottom, and how we drifted about in what was then a heavy sea, and how, for 48 hours, there seemed to be no definite plan determined upon on the part of the officers; no boats in readiness, no sails put up, which, if they had had them, on account of the hydraulic machinery and *saloon roof* in the way, could not have been used successfully; no rockets sent off for two nights—three red lights only gave notice of our distress. We had a favorable wind, and if sails could have been used we could have made the coast in three days. We drifted about until Friday morning, with water filling to a greater depth the compartments each hour, when the *Adriatic*, of the White Star Line, came to us with a small steamer called the *Aldersgate;* the former steamed away to New York, and the latter agreed to tow us, if possible, and, if they failed in that, to take the passengers to Queenstown. The third day matters were better organized. Much credit, I think, is due the chief engineer and carpenter for the intelligent and energetic work accomplished in strengthening the bulkheads between the engine and boiler room, which moved 2½ ins., due to the pressure of water against them. In the engine room strong shores made from spars were placed against the bulkhead, and all the water was taken out of the three boilers in the compartment next the engine room, and all outlets plugged to give buoyancy to the ship. Had the water broken through this bulkhead nothing could have saved the steamer. The water was about 20 ft. above the boiler room floor in the engine room When we left the steamer she had taken in 1,500 tons in engine room, 750 tons in compartment No. 10, 50 tons in No. 11, 450 tons in No. 12—a total of 2,750 tons, carrying in addition her entire cargo.

What caused this accident? will be asked by many interested people. The truth, perhaps, will never be known, but the probable cause may, perhaps, be found among the following, which are offered simply as probable causes:

I am informed by a gentleman of intelligence, who is capable in all mechanical matters, that he was standing at the stern of the steamer watching the propeller blades cut the water, leaving the spiral traced behind the screw in well-defined lines. He had just left the port side and was half way over to the starboard side of the steamer when the accident occurred. After the vibration and noise had ceased, he looked over to see if there was any difficulty with the propeller on the starboard side. He informs me that the propeller was slowly rotating, caused, no doubt, by the forward motion of the steamer. If this be the fact, then possibly the propeller shaft had, at that time, been broken.

The piston rests upon a shoulder solidly connected with the piston rod, and to which the piston was bolted with 8 bolts, no key or pin being used. The size of the bolts was not learned. The diameter of the tail rod is 8 ins., diameter of piston rod, 10 ins. The connecting rod is 8¾ ins. diameter at the upper end and 11¼ ins. diameter at the lower end. The crank pin is 21 ins. in diameter and 26 ins. long; crosshead pin, 10 ins. in diameter.

The writer is strongly impressed with the idea that the primary cause of the accident will not be found in a failure of the propeller or crank shaft, but in the loosening of the piston, and then breaking away from the piston rod, or the breaking of the piston rod. The greatest injury may have been done after the large cylinder was demolished by the running away of the two high-pressure engines on the starboard side, which must for a few seconds, judging from the sound and the noise of the closing disturbance, have twisted and slashed about connecting rods, eccentrics and other parts through the engine room in the most destructive manner, breaking columns of the large engine, bed plates, and shaft. The running of the two engines referred to may have been stopped only by a change in the position of their valves, due to the excessive vibration, and no doubt slipping of the eccentric, or breaking of some essential part, when they stopped themselves. It is a fact beyond controversy that the starboard engines, after the large engine was smashed to pieces, operated for a short time and then stopped.

The piston area of the first cylinder is 1,590.43 sq. ins., the second cylinder 3,959.2 sq. ins. and the third, or the one that collapsed, is 10,028.77 sq. ins. Considering only the large cylinder, and assuming that the steam pressure at the beginning of the stroke equaled 12 lbs., to which must be added the atmospheric pressure operating, with a vacuum, making approximately a M. E. P. of not less than 20 lbs. per sq. in. on the large piston, or a total pressure on the entire piston of 201,575.4 lbs., over 100 tons, thus giving to the piston a high velocity which places it quite close to, if not beyond, the danger line.

The usual piston speed of the large engine is, perhaps, too high when the details and the heavy moving parts are considered. The total weight of piston, piston-rod and cross-heads equals 16½ tons, which weight is started from a state of rest to a speed of 880 ft. per minute, and sometimes 950 ft. per minute, in a distance of about 2½ ft., and stopped again within the same distance. There is no doubt as to the piston on other occasions having reached a much higher speed than that given, as this steamer has a record of over 500 miles per day. I need not enter into computations to show the resistance necessary to check so great a weight as the piston and co-parts in the short distance in which it was accomplished. A liberal cushion at the lower and upper end, and piston valves do not eliminate the danger of driving a piston of the weight given at the speeds mentioned, depending on the details adopted in the engine in question. In order to comply with government regulations and place the machinery below the water line, a short stroke had to be adopted. If high speed is what is desired and looked for by marine engineers, the details associated with the moving parts on engines that approach the diameter of cylinders such as the one in question on the *City of Paris* must be materially strengthened and modified.

As remarked before, the *City of Paris* has the most complete hydraulic appliances imaginable; but, notwithstanding this fact, while floating about helpless on the sea, had it been necessary to use the anchor it could not have been done unless by hand. Had it been necessary to unload the cargo in order to lighten the ship, the hydraulic machinery could not have been used, and this unloading could only have been done by *hand power*, blocks and falls; neither could the ship have been steered by the hydraulic power. It was helpless for these purposes; in fact, there were no means of doing any heavy work except by hand, all due to the fact that the pumps that operated the hydraulic machinery were under water in the engine room, and thus this "complete hydraulic system" was paralyzed. There was no lack of steam supply, for not less than 15,000 H. P. were available in the shape of steam during the entire period or time we were drifting. If steam-hoisting engines had been provided at various points on the steamer's decks, and circumstances required, the cargo could have been discharged, the anchor lowered or raised, and other work performed.

The same is true of the pumps. The boiler room was well supplied with pumps, as was the engine room, but the compartments outside the engine and boiler room were not. One of the most discouraging sights during the trying accident was the slow but constantly rising water in the state rooms aft of engine room, and the washing back and forth of great volumes of water, smashing in doors, stateroom partitions, and mixing in general confusion doors, mattresses, furniture, etc.; men almost exhausted with work at small hand pumps, others knee deep in water bailing with *pails* in repeated efforts to reduce the water in the compartments. In this respect the officers and crew did well, and used every available means at their command; but hand pumps and pails seemed out of place in an emergency of this kind; steam pumps were needed, but none could be had. One small pump was taken from the boiler room, placed above the water in the engine room, connections made, and it started to pump. It was like a leaf in a hurricane. The *City of Paris* was not saved on account of the skill or any special means of safety developed by the officers and crew, but her escape was due entirely to the providential weather experienced for four days and to water-tight bulkheads.

## Electric Subways and Gas Mains.

The New York Senate Committee on General Laws is apparently contemplating the establishment of a State Supervisory Board, whose duty it shall be to take general charge of all underground pipe system, and to supersede the Board of Electrical Control in New York City.

In this connection Mr. HENRY S. KEARNEY, Chief Engineer of the Board of Electrical Control, has been called upon to testify before this committee on the gas and subway question in New York City. Mr. KEARNEY said that the city is gridironed with gas mains ranging from 4 to 20 ins. in diameter. In some streets, and on Sixth Ave. especially, there are four sets of gas mains on each side of the street. Mr. KEARNEY says that gas is continually escaping from these mains from leaking joints, and he believed that in 95 out of 100 holes dug in the streets between 14th and 23rd Sts. and Third and Ninth Aves., escaping gas would be found before the main was reached. In laying the conduits he found many gas mains so corroded that they broke in handling, and also found old service "cut-offs" made by simply hammering the ends of the pipes together.

Mr. KEARNEY says the steam-heating pipes also gave them much trouble. Ten feet below the surface of Broadway, from Howard St. to Exchange Place, the temperature of the earth was above 100° F., caused by escaping steam from defective joints. This heat, in combination with acids in the soil, destroys the insulation on underground wires. The Telephone Company has been forced to lay a new cable especially prepared to resist these effects. The brass pneumatic tubes of the Western Union Telegraph Co., laid three years ago, are also badly corroded from these causes. Mr. KEARNEY thought these evils could be remedied, and was in favor of a supervisory board to control "the gas and steam companies."

Mr. JAMES W. SMITH, President of the Consolidated Gas Co., appeared for the defence. He said

that the gas mains were laid under inspection, and were as tight as it was possible to make them. They were injured by the frequent and careless tearing up of the streets. He said the quantity of escaping gas was over estimated; instead of 8 or 10 per cent., as stated by Mr. KEARNEY, he did not think it was over 1 per cent. Mr. SMITH claimed that the subways had been laid with absolute recklessness, and without regard for the rights of other underground work. In some places they had built solid brick and cement structures right on top of gas mains. Other experts are to testify later.

## Statistics of Railway Construction.

### NEW BRUNSWICK AND NOVA SCOTIA.

**Existing Roads.**

1. ***Canadian Pacific.***—Surveyed, Harvey to Salisbury, N. B., 113 miles.

2. ***Central R. R. of New Brunswick.***—Track laid in 1889, Norton, N. B., to Chipman, 44 miles. Surveyed, Doakton to Chipman, N. B., 30 miles; Norton to St. John, N. B., 35 miles.

3. ***Cumberland Ry. & Coal Co.***—Track laid in 1889, end of track to Oxford, N. S., 14 miles.

4. ***Grand Trunk.***—Surveyed, Edmundston to Perry's Mills, N. B., 180 miles.

5. ***Intercolonial.***—Oxford & New Glasgow R. R.—Track laid in 1889, Oxford to River John, N. S., 47 miles; Pigwash to Pigwash Village, N. S., 5 miles. Cape Berton Ry.—Port Hawkesbury to Sydney, Cape Breton Island 90 miles. Under survey, North Sydney to Louisburg, 25 miles.

6. ***Inverness.***—Graded, Port Hawkesbury, Cape Breton Island north, 16 miles. Projected, end of grade north 50 miles; branch to Cape Berton Ry., 20 miles.

7. ***New Brunswick & Prince Edward Island.***—Surveyed, Sackville, N. B., to Wild Point, 5 miles.

8. ***Nova Scotia Central.***—Track laid in 1889, end of track to Lunenburg, N. S., 39 miles. •Projected, Middleton to Margarettsville, N. S., 8.5 miles.

9. ***Nova Scotia Midland.***—Under construction, New Glasgow to White Haven, N. S., 60 miles.

10. ***Salisbury & Harvey.***—Surveyed, Harvey to Alma, N. B., 12 miles.

11. ***Stewiacke Valley & Lansdown.***—Under construction, Brookfield to Lansdown, N. S., 37 miles. Surveyed, Brookfield to Hants Central R. R., 15 miles.

12. ***Tobique Valley.***—Track laid in 1887, Perth Station to Poquoque, N. B., 5 miles. Track laid in 1890, Poquoque to end of track, 2 miles. Graded, end of track towards Plaster Rock, 10 miles. Surveyed, end of grade to Plaster Rock, 14 miles.

13. ***Western Counties.***—Under construction, Annapolis to Digby, N. S., 20 miles.

**Projects and Surveys.**

14. ***Chedabucto Bay.***—Projected, Intercolonial Ry. to Cape Canso, N. S., 45 miles.

15. ***Halifax Northeastern.***—Projected, Halifax Harbor, N. S., to Hunt's Central R. R., 50 miles.

16. ***Hunt's Central.***—Surveyed, Windsor to Truro, N. S., 50 miles.

17. ***Louisburg & Port Hawkesbury.***—Projected Louisburg, Cape Breton Island, to Intercolonial Ry. 65 miles.

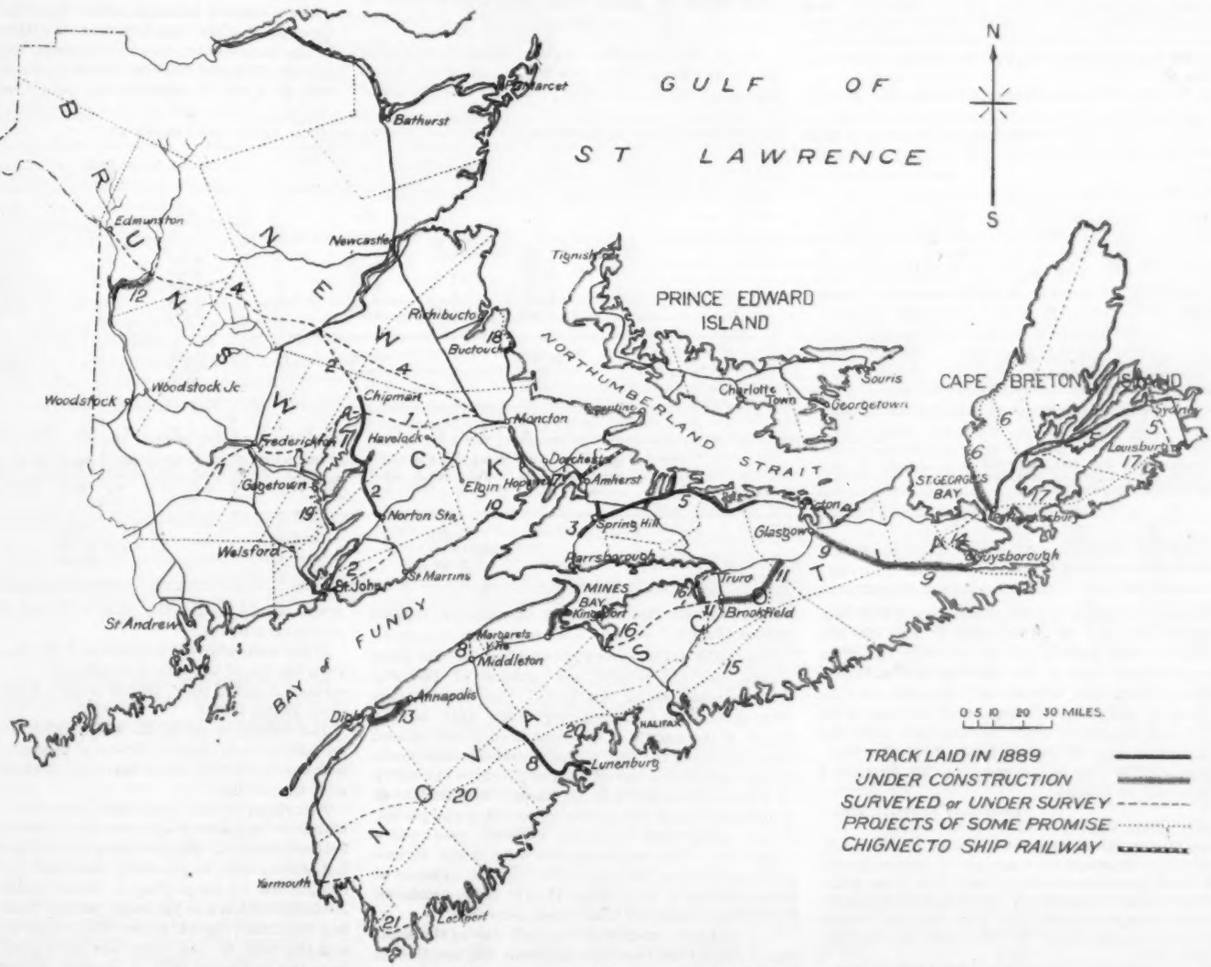
18. ***Moncton & Prince Edward Island.***—Projected, Buctouche to Richbucto, N. B., 20 miles.

19. ***St. John Valley.***—Projected, Gagetown to Welsford, N. B., 25 miles.

20. ***Yarmouth & Halifax.***—Projected, Yarmouth & Lockport Ry. to Halifax Harbor, N. S., 150 miles.

21. ***Yarmouth & Lockport.***—Under survey, Yarmouth to Lockport, N. S., 80 miles.

*Total.*—Track laid in 1889, 244 miles. Track laid since Jan. 1, 1890, 2 miles. In process of construction, 143 miles. Surveyed or under survey, 560 miles. Projects of some promise, 433 miles.




**Map Showing Progress of Railway Construction in the Eastern Canadian Provinces.**

## The Walnut Grove Dam Failure.

The *Courier*, of Prescott, Ariz., publishes a letter from Mr. W. H. BATES, of New York, in answer to strictures upon the failure of the Walnut Grove dam and those responsible for it, that has an interest to our own readers, especially as our late editorial upon this disaster was in some part based upon the printed accounts of our Western contemporaries.

In brief, the *Courier* editorially charges that the dam was faulty in construction, due to a desire to float stock and make money out of the enterprise, with the least expenditure on the works themselves. To this editorial Mr. W. H. BATES, of New York, whom we included among those chiefly responsible for the plans, answers that with one exception the original promotors of the Walnut Grove Water Storage Co. and the investors therein, "stayed with the ship and have gone down with her." About two years ago Mr. NEWBERRY sold his interest to Mr. HENRY S. VAN BUREN, of New York, who, with his family, control the enterprise by possessing a great majority of the stock and suffer the loss of the money invested.

Mr. BATES goes on to say that he has devoted a large part of his best efforts for the past seven years in attempting to bring this enterprise to a successful end; and in so doing encountered many obstacles, not the least of which was that of convincing eastern capital that it ever rained enough in Arizona to fill a large storage basin. "Future promoters of similar enterprises will not have this difficulty to contend with." In replying to the many criticisms upon the construction of the dam, Mr. BATES says that a sufficient answer to this is that the water poured over the top of the dam for some time before it broke, though the dam was not designed for such overflow; hence the criticism should be directed against a waste-weir which failed to perform its duty, and not against the dam which really performed more than its calculated duty.

Mr. BATES then comments at length on a point well known to engineers; but as it defines his connection with the inadequate capacity of this waste-weir we quote this part of his letter. He states that Mr. B. S. CHURCH, C. E., late Chief Engineer of the New Croton Aqueduct, visited this dam in December of 1889, and strongly commented on the insufficiency of the wasteway. Mr. BATES then says:

Mr. VAN BUREN, president of the company, who has had the active management of the company's affairs for nearly two years, had already commenced enlarging the wasteway. I confess the force of workmen was the most agreeable sight I saw while in Arizona the last time, for I had always contended, to the utmost of my power, for an ample wasteway. I had seen the Hassayampa in the early spring of 1884, and again in 1885, and knew what an immense volume of water could come down from the mountains. My arguments advocating

a larger wasteway were met by what occurred a year ago. Your readers will remember the storm that washed away Judge ABNER WADE'S residence, standing on the banks of the reservoir. During that storm the reservoir filled to within a foot of the top of the dam. A jam of logs had stopped up the wasteway, and, but for the fact that the jam was broken, the water would have gone over the top of the dam, and it would doubtless have been destroyed at that time.

As soon as the wasteway was free of logs, it performed its duty fully, discharged the surplus water, and the reservoir soon lowered several feet. Precaution had been taken to prevent another jam of logs, and I learn the wasteway had been made some larger.

It is quite evident that the storm of a year ago was merely a shower compared to the late storm which carried away the dam. I am informed that with the wasteway running clear and full, and both pipes open, the water still continued to rise until it ran over the top of the dam three feet deep, for six hours. The dam was over 400 ft. long on top. It was less than 100 ft. at the bottom; hence, this vast volume of water, 400 ft. by 3 ft. must have been concentrated to a current less than 100 ft. wide by the time it reached the bottom. Add to this the fact that the water had a fall of over 100 ft., and the only wonder is that the dam stood it as long as it did, that is, from 8 P. M. to 2 A. M.

In his letter to the Prescott *Courier*, Mr. BATES refers to a professional opinion concerning this dam obtained from Mr. B. S. CHURCH, C. E. As Mr. CHURCH is well known as an engineer, and as he visited the dam only a few months before its destruction, his opinion is especially valuable as coming from the only engineer capable of judging of its merits and demerits, and unconnected with the work, from whom the public has had an opportunity to hear. For this reason we give Mr. CHURCH'S letter in full, as follows:

NEW YORK, March 27, 1890.

*Wells H. Bates, Esq.*, 11 *Wall St., New York:*

DEAR SIR: In answer to your inquiry as to my professional opinion regarding the cause of the destruction of the Walnut Grove Dam, I have to say that in my judgment the disaster was evidently due to an underestimate of the volume of water which the waste-weir, cut in rock at the end of the dam, would be called upon to pass during flood times.

The dam itself was of ample weight and dimensions. The construction was sufficiently good and the foundations solid. But the dam was intended to act only as a reservoir embankment wall, built entirely of stone, over which it was designed that no water should ever pass.

The solidity of the structure of the dam itself is at tested when you consider that it sustained a flow 3 ft. in depth over its crest for six hours before yielding to that extraordinary denuding dynamic force. Its action under such abnormal conditions simply proved how well it could have sustained its legitimate static pressures.

Prior to my last visit to Arizona, you personally consulted me as a disinterested engineer not connected in any way with the work, about enlarging the waste-weir. When we visited the dam December last the work of enlarging its waste-weir was in progress. It is important that the lesson to be learned from this disaster should not be misinterpreted. The failure of a weak bridge, or the collapse of a badly supported tunnel involving loss of life and property, does not condemn the future building of railroads, or the continuance of mining operations. Neither should the casualties resulting from too restricted flood-gates, and waste-weirs militate against the future building of high storage dams, if provided with ample appurtenances to enable such dams to perform their legitimate functions with safety.

With but few exceptions the destruction of high dams has been due to insufficient wasteways, and defective, unmanageable flood gates, rather than to weakness in the dams themselves. The sad catastrophe overtaking the "Walnut Grove Dam" proves the importance (by no means generally realized by the public) of placing engineering works of such magnitude in the hands of experienced experts thoroughly competent to deal with all the hydraulic problems involved.

The building of a solid wall capable of resisting the pressure of a great depth of water is but one part of many factors that enter the calculations for requisite safety in connection with such structures. Therefore it is to the interest of true economy on the part of companies, as well as for the protection of outside interests, that engineering works of this nature should not alone be planned, but executed, under the supervision and direct personal responsibility of some professional man of established ability.

Very truly yours,
B. S. CHURCH, Civil Engineer.

## The Wear of Rails from Different Grades of Steel.

Mr. J. W. Post, Chief Engineer of the Netherlands State Railways, has given in the *Organ des Eisenbahnwesens* some notes of experiments recently made on that line on the durability of rails of various grades of steel.

The rails were carefully weighed at the steel works, and the weight and number of the run stamped and painted on each. The observations were made with a micrometer every year on the height of the middle of the head, at regularly spaced intervals along the rail. The measurements made at the steel works served as zero points in the curve of wear. By exact readings taken to hundredths of a millimeter, and the measurement of many places, it was endeavored to obtain valuable results in a short time. The measurements were made at two points on each of 150 rails. The limited number of trains during a day, from 13 to 18 only, rendered these observations of little value, however.

The slightest canting of the rail due to the sinking of part of the base into the cross tie, resulted in the loss of the rail for purposes of measurement. In these cases, the most careful observations would sometimes give a negative wear, that is, show that an increase in the height of the section had taken place. This was out of the range of probabilities.

The rails were laid on the double track between Venlo and Eindhoven, and consequently were passed in one direction only. The track is a tangent, sufficiently far from stations to avoid the friction of the wheels when the brakes are set. The rails are 29.53 ft. long, and weigh 67.97 lbs. a yard when new. They are 5.06 ins. high, and are supported by 10 cross ties under each. Steel angle bars are used. The speed of the trains is 46.6 miles an hour according to the time table. The ballast is river sand.

It would have been possible to measure several points at each section, but this would necessitate so many accurate measurements that it was decided to make the observations in another way. Accordingly, after 1,833 days had passed and 26,120 trains had moved over each rail, a number were taken up. They were carefully cleaned with steel brushes and then weighed. The difference between the original weights and the later ones gave the loss due to wear and rust.

As the table shows, the 16 rails were from four runs of steel. The runs marked A and B contained 0.40 and 0.36 per cent. of carbon, and the steel had an ultimate strength of 92,880 lbs. and 92,740 lbs. per sq. in. The wear of the rails of A and B steel amounted to about 12.297 oz. per yard.

The runs E and H contained only 0.23 and 0.19 per cent. of carbon, and had an ultimate strength of only 73,820 and 67,420 lbs. per sq. in. The wear of the rail through use and rust amounted to 15.65 oz. per yard.

This slight loss of a few pounds in the weight of each rail could take place only in the outer layers of metal, and it would be wrong to draw conclusions from these experiments as to the wear of the rails during their entire life. In order to know if the deeper layers of the head will wear as the parts compacted by the rolls we must have more observations.

If we assume, however, since there is no ground for expecting the contrary, that the later wear is to be the same as that already observed, then it would take 68,556 trains to reduce each yard section of the rails of A and B steel by one pound, while 53,856 trains would reduce the rails of E and H steel by the same amount.

If the wear allowed to a rail is 7.263 lbs. per yard, then the life of the rails is as follows:

From A and B steel, 246,802 trains; from E and H steel, 193,882 trains.

The difference of 52,920 trains, with an average velocity of 14.25 trains a day as at present, shows an increase in the life of the first rails of about 10 years over the second.

Therefore, if the wear and rust were the only things to be guarded against, hard steel is plainly better than soft. Nevertheless the danger of having broken rails is generally believed to be much diminished by employing a lower grade of metal. Although it has not yet been proved that high carbon steel rails break more often than the others, and the rails of this class are giving satisfaction here and in France, still it seemed prudent to our directors to adhere to their old specifications for 68 lb. sections of an ultimate strength of at least 73,960 lbs. per sq. in. But since 1885 the only sections employed have been those of 80.68 lbs., and the above results have caused the lowest allowed ultimate strength to be raised to 82,490 lbs. per sq. in.

These experiments are being continued by the Netherlands State Railways, and the directors hope to be able to enter on a series of investigations on the effect of aluminum, chromium, and other elements in rail steel.

As regards comparison of the above results with other observations Mr. WELLINGTON states in "The Economic Theory of the Location of Railways," p. 119:

> The average life of good steel rails properly manufactured and inspected so as to eliminate all imperfections arising from a lack of ordinary care and skill, and weighting 60 to 80 lbs. per yd., according to the weight of engine, has now been determined with a considerable approach to certainty to be about 150,000,000 to 200,000,000 tons, or (what is probably a more correct way of putting it) from 300,000 to 500,000 trains. From 10 to 15 lbs., or ⅝ to ⅝ in. in height of the head of such a rail is available for wear, and abrasion

OBSERVATIONS ON WEAR OF STEEL RAILS—NETHERLANDS STATE RAILWAYS.. DOUBLE TRACK; BETWEEN VENLO AND EINDHOVEN.

| Steel | Hard. | | | | | | | | Soft. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Run | A. | | | | B. | | | | E. | | | | H. | | | |
| Silicon, per cent | 0.132 | | | | 0.315 | | | | 0.117 | | | | 0.032 | | | |
| Sulphur " | 0.067 | | | | 0.052 | | | | 0.080 | | | | 0.054 | | | |
| Phosphorus " | 0.065 | | | | 0.087 | | | | 0.072 | | | | 0.065 | | | |
| Manganese " | 0.529 | | | | 0.637 | | | | 0.702 | | | | 0.691 | | | |
| Carbon " | 0.400 | | | | 0.360 | | | | 0.230 | | | | 0.190 | | | |
| Ultimate strength in lbs. per sq. in. | 92,877 | | | | 92,740 | | | | 73,820 | | | | 67,420 | | | |
| Contraction in per cent. | 42.2 | | | | 46.5 | | | | 49.9 | | | | 46.7 | | | |
| Elongation in per cent. (Bar length, 200 mm) | 17.6 | | | | 17.9 | | | | 20.8 | | | | 21.8 | | | |
| Rail marked | $A_1$. | $A_2$. | $A_3$. | $A_4$. | $B_1$. | $B_2$. | $B_3$. | $B_4$. | $E_1$. | $E_2$. | $E_3$. | $E_4$. | $H_1$. | $H_2$. | $H_3$. | $H_4$. |
| Weight of new 9-m. rail, in pounds | 651.6 | 677. | 664.8 | 664.8 | 671.4 | 678. | 653.7 | 670.3 | 662.6 | 661.5 | 669.2 | 667. | 669.2 | 665.3 | 662.6 | 663.2 |
| Weight of rail after use, in pounds | 643.8 | 669.6 | 657.3 | 656.4 | 664.8 | 670.5 | 646. | 663.2 | 653.7 | 650.9 | 659.7 | 657.7 | 659.2 | 656.1 | 652.6 | 653.3 |
| Loss per rail, in pounds | 7.8 | 7.4 | 7.5 | 8.4 | 7.6 | 7.5 | 7.7 | 7.1 | 8.9 | 10.6 | 9.5 | 9.3 | 10.0 | 9.2 | 10.0 | 9.9 |
| Number of days in use | 1,833 | | | | | | | | 1,833 | | | | | | | |
| Number of trains in a day | about 14.25 | | | | | | | | about 14.25 | | | | | | | |
| Total number of trains | 26,120 | | | | | | | | 26,120 | | | | | | | |

takes place at the rate of about 1 lb. per 10,000,000 tons, or one-sixteenth inch per 14,000,000 to 15,000,000 tons.

This corresponds closely with the above, except that it allows more wear from the head, viz., 10 to 15 lbs. instead of 7.26 lbs., the last being the limit which modern experience tends to support.

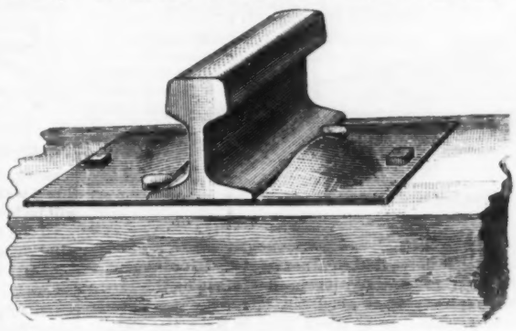
## The Shoulder Tie-Plate.

The wooden tie seems likely to remain in use for many years to come, and efforts are constantly being made to increase their life and to make them more safe under the present heavy rolling stock.

The engraving herewith represents a recently patented tie-plate whose projectors claim that it will increase the life of the wooden tie besides making the track safer and more perfect, as regards line and surface.

By the form it will be seen that not only is it devised to give the rail a more extended bearing on the tie and bring into use the inside spike to resist the lateral thrust of the rail, but also to prevent the widening of the gauge and the consequent wearing away of the spike at the neck.

The plates are made of ¼ in. steel plate, stamped to the form shown in the cut, to fit the various sizes of rail bases. It is 12 ins. in length and 5 ins. in width, thus giving the rail about three times as much bearing surface as it now has.



The Shoulder Ti e-Plate.

The shoulders are stamped up the thickness of the flange of the rail, or about ⅛ in., and the plate complete weighs a fraction over 4 lbs.

A number of these tie plates are now in service under trial on the Pennsylvania tracks at Harsimus Cove, Jersey City, at the point of their heaviest freight traffic, and are said to be giving great satisfaction.

It has been suggested that it might be more effective to substitute for the present shoulder on the plate two small "lugs" or "tits" stamped up in the manner of the shoulder, which would effect the same results against lateral thrust, and 9 ins. greater bearing surface. This is now under consideration. Further information as to the plate, which was patented Oct. 22, 1889, can be obtained from Mr. CHAS. D. HALSEY, care Pennsylvania R. R. Co., Jersey City, N. J.

## Experience with the Strong Locomotive on the Cincinnati, Hamilton & Dayton; and the New Works of the Strong Locomotive Co.

One of the five locomotives built by the Strong Locomotive Co. has been running for about 18 months on the Cincinnati, Hamilton & Dayton R. R., and the Cincinnati *Commercial Gazette* publishes comments upon the engine by General Superintendent NEILSON, from which we abstract the following:

The Strong engine has capacity for handling a large train in a most remarkable manner, and has given us a great deal of satisfaction. I have ridden on the Strong engine, pulling 7 cars, at the rate of a mile in 42 seconds, for some distance. The grade was not absolutely level, but a grade of from 10 to 15 ft. per mile, up grade. We made one mile, I remember, on practically a level or slightly down hill, as near as I could get at it with a stop-watch, in 40 seconds. I am not very much in favor of this rate of speed, as you may imagine; but what I do like about the engine, and what is the strong point in her favor, is the fact that I have been on her when she ran up hill 8 miles, with 9 heavy vestibule cars, making fair schedule time, and arriving at the top blowing off steam and carrying a steam pressure of 170 lbs.

As to coal consumption, the engine uses, as nearly as we can determine by the ordinary appliances, about one-third less coal than an ordinary engine doing the same work. This saving I account for by the thorough combustion secured. In the common engine about twice as much fuel has to be burned per sq. ft. of grate as in the Strong engine. This requires so heavy a draught as to tear the fire and carry unconsumed coal over into the front end. In the Strong engine a much lighter draught, giving less back pressure, is sufficient to keep up steam, and less coal is carried off unconsumed. As the furnaces are fired alternately, the gas from one is burned by the other. Thus it is possible to have a train free from cinders and smoke while the locomotive burns soft coal, a most important point in conducting passenger traffic.

The engine weighs 133,000 lbs., which is much heavier than is required for our traffic; yet the load is so distributed that the engine rides like a Pullman car, and is actually easier on the joints and rails than an ordinary 100,000-lb. engine.

There is every reason to believe that the Strong boiler will have three or four times the life of an ordinary boiler, for these reasons: The fire-box of an ordinary boiler is the troublesome part, and is the part that is liable to give a great amount of trouble, held together by a multitude of stays and braces, which accumulate the sediment and scale that is deposited by the evaporation. Water in the States of Ohio and Indiana is so hard that is a very important question to us, in fact so much so that our fire-boxes as a rule last from 25 to 30 per cent. of what should be the life of a fire-box. On one division 25 per cent. would be a liberal allowance for the life of a fire-box as compared with portions of the Erie. In the construction of Mr. STRONG'S boiler and fire-box, by reason of the corrugated cylindrical surfaces presented by the fire-box, free from stays or crown bars, it is impossible for the scale to accumulate. There is nothing to hold it, and the slight contraction and expansion cause it to crack as fast as it is formed, and drop down, and is washed or blown out when the boiler is cleaned. As an illustration of the above statement, I can positively state that these fire-boxes were examined carefully, after 18 months' service, about two weeks ago in our shop. They were found to be absolutely free from scale, which is the first time in the history of the road that this has occurred.

The liability of the boiler to leakage is also much less than in an ordinary boiler, since there are no lap seams in the fire box and not a rivet head or plate edge exposed to the fire. The furnaces are joined to the junction piece between the fire boxes and combustion chamber by what is known as the Adamson seam, by the use of which there is nowhere more than a single thickness of metal between the fire and the water, and these surfaces always being clean insures perfect contact, which prevents overheating of the metal.

As noted some weeks ago, works are to be erected at Cincinnati by the Strong Locomotive Company for the manufacture of locomotives. A tract of land 1,750 acres in extent has been purchased, and it is intended to build a manufacturing village here with the Strong works as a nucleus. Among the capitalists interested are JAS. H. STEWART, M. D. WOODFORD, MATTHEW ADDY, C. NEILSON, GEO. S. STRONG and EUGENE ZIMMERMAN. The works will be reached by the Pennsylvania and Vanderbilt systems and the Cincinnati, Hamilton & Dayton, thus giving the company excellent facilities for shipment. The works will consist of machine shop, erecting shop, paint shop, tank and truck shop, boiler shop, boiler erecting shop, forge shop, foundry, pattern storage room, wood-working shop and boiler house.

In the design of the shops much pains will be taken to facilitate the transfer of work and material from one shop to another without hand labor. This is effected by laying tracks all through the works, on which light switching engines can run, and by a liberal provision of transfer tables and overhead cranes. The bridge crane in the machine shop will be 65-ft. span, with a capacity of 30 tons. In finishing work milling machines will be generally given the preference over planers.

In the erecting shop an overhead crane able to lift a 60-ton locomotive will be put in, and a 50-ft. transfer table will also be provided.

In the boiler erecting shop it is intended to use portable reaming machines instead of the much condemned drift pin; and pneumatic caulking machines will be provided.

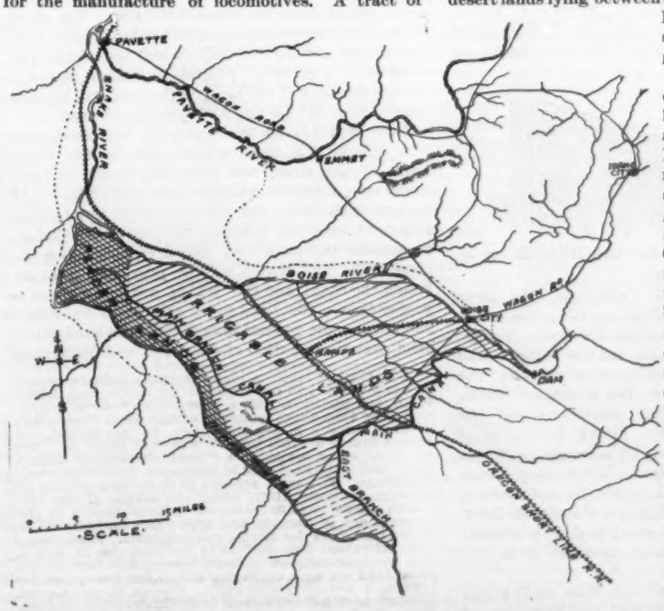
In the boiler construction shop it is stated that a plant will be put in capable of welding both the longitudinal and circumferential seams of boilers, an idea which was long ago broached, but has never yet been carried into practice. The corrugated steel furnaces used in the Strong boiler will also be made in this shop. A liberal provision of hydraulic flanging presses will be made, and in the forge shop also these machines will be largely used.

The boilers will be set in a house by themselves, and steam will be carried by underground mains to compound condensing engines in various parts of the works. Strong's patent boilers will be used, carrying 160 lbs. pressure, and burning bituminous slack, which can be delivered at the works at a cost of a dollar a ton. A gas-producer will also be put in to furnish fuel gas for forge fires, etc.

The works will cover an area 700 x 500 ft. Their estimated capacity is one locomotive every nine hours, or if worked double turn, two locomotives per day. While the specialty will be the Strong locomotive, it is intended to enter the market in competition with existing locomotive builders, and turn out any type of engine which railway mechanical officers may demand.

## Irrigation in Idaho.

An interesting report is issued by A. D. FOOTE, C. E., on the irrigation and reclaiming of certain desert lands lying between Snake and Boise rivers in Idaho, as shown on the sketch map herewith given.



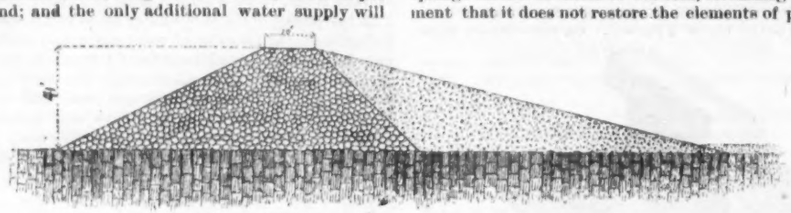

Idaho Mining and Irrigation Co. General Map.

The area to be irrigated, including the "placer lands" indicated, cover about 350,000 acres. The Boise River, on which the reservoir is to be built for supplying the main irrigation canals, has a catchment basin of about 1,000,000 acres. The river heads in the Saw Tooth Mountains of Central Idaho, but the amount of moisture falling in this region, chiefly in the form of snow, is wholly a matter of conjecture, as no statistics are to be had. Reasonably accurate measurements, however, have been made through four years of the discharge of the river throughout the year. The lowest discharge is in January and February, when the volume ranges from 1,200 to 1,500 cu. ft. per second. The highest

is in May and June, when it starts with 5,000 cu. ft., ranges to 30,000 cu. ft., and by July 1 falls to 10,000 cu. ft. per second. The rise is gradual, commencing about March 1 and reaching its maximum in June.

Mr. FOOTE located five reservoirs in all on the upper waters of the Boise River, with a combined capacity of 9,618,000,000 cu. ft., or 111 days' supply at 1,000 cu. ft. per second. The dams would be built of loose rock and gravel, or gravel alone, estimated at 35 cts. per cu. yd. for the first and 20 cts. per cu. yd. for the second type of dam.

The maximun discharge of the main canal, as will be shown further, is figured at about 4,000 cu. ft. per second; and the only additional water supply will



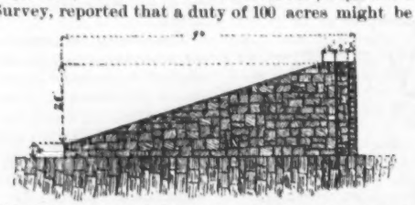
**Boire River Dam; Cross-Section.**

be required between July 15 and Sept. 1. As shown above, the reservoir would supply 1,000 cu. ft. per second for 111 days. The "duty of water" is difficult to ascertain in an untried locality, and the experience in different localities gives varying results, as is shown by the following table compiled by Mr. FOOTE:

TABLE SHOWING THE DUTY OF WATER IN VARIOUS LOCALITIES.

| LOCALITY. | Duty of Water. | AUTHORITY. | |
|---|---|---|---|
| | ACRES. | | |
| Jumna canal, India | 306 | E. B. Dorsey, C. E., Trans. Am. Soc. C. E. | |
| Ganges " " | 232 | " " " " " " " | |
| Canals of Upper India | 267 | " " " " " " " | |
| Canals of India, average | 250 | Lieut. Scott Moncrieff, R. E. | |
| Genil Canal, Spain | 240 | E. B. Dorsey, C. E., Trans. Am. Soc. C. E. | |
| Henares " " | 157 | Geo. Higgin, C. E. | |
| Canals of Valencia, Spain | 242 | E. B. Dorsey, C. E., Trans. Am. Soc. C. E. | |
| " Northern Peru | 160 | " " " " " " " | No rain-fall. |
| " " Chili | 190 | " " " " " " " | No rain-fall. |
| " Lombardy, Italy | 90 | Baird Smith, R. E.—Including Rice Crops. | |
| " Piedmont, " | 60 | " Including Rice Crops. | |
| " Southern France | 60 | Lieut. Scott Moncrieff, R. E. | |
| " Algeria | 140 | Hall, State Eng. California. | |
| " Kern Co., Cal | 106 | " " " " | |
| " Los Angeles, Cal | 300 | " " " " | |
| " San Bernardino, Cal | 300 | " " " " | |
| " Tulare & Fresno, Cal | 130 | " " " " | |
| S. Joaquin & King's R. Canal, | 150 | " " " " | |
| Chowchilla Canal, Cal | 150 | " " " " | |
| Canals of Utah Territory | 100 | C. L. Stevenson, C. E., Trans. Am. Soc. C. E. | |
| Canals of Colorado | 100 | Nettleton, State Eng., Colorado. | |
| " Cache la Poudre, Colo | 103 | Prof. Mead, C. E. " | |

Mr. J. D. SCHUYLER, in writing of the duty of water, says 150 acres per cu. ft. per second should not be taken as an unreasonably high duty. The U. S. Commission on Irrigation, composed of Gen. B. S. ALEXANDER, Col. GEO. W. MENDELL, U. S. Engineers, and Prof. GEORGE DAVIDSON, U. S. Coast Survey, reported that a duty of 100 acres might be



**Side Elevation of Pier for the Head-Gates at Dam.**

calculated upon for Central California. The average duty as given in the foregoing table for localities in the United States is about 170 acres; though, owing to the scarcity of water and the value of land in Los Angeles and San Bernardino counties, the duty there given is far above the average. Taking into consideration the climate, character of soil and method of distribution, Mr. FOOTE feels assured that he is safe in estimating 150 acres per cu. ft. per second for the lands in the Snake River valley. Therefore, 4,000 cu. ft. per second would be sufficient to irrigate 600,000 acres, the ultimate of irrigable land, during 90 to 100 days in the year, and it is already shown that this amount can be obtained from the Boise River.

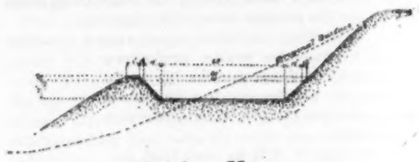
The appropriation for water has been made under the laws of the United States and the Territory of Idaho, and consists of 225,000 miner's inches, or 4,700 cu. ft. per second.*

Mr. FOOTE points out the value of silt-bearing waters in increasing the fertility and value of lands previously barren. He illustrates this feature by numerous examples in foreign experience, as in the difference between the silt-bearing water of the Durance Canal and that of the clear, cold water of the Sorgues, which induces cultivators to pay twelve times as much for the former as for the latter water. In Los Angeles Co., Cal., says Wm. HAMMOND HALL, clear, pure water from artesian wells and springs carries so little of the rich, fertilizing sediment that it does not restore the elements of plant growth to the soil, and consequently enrich it; and he further notes that in other sections the sediment in the irrigation water has been retained on the surface and has made good soil, where it did not previously exist. It is noted that in Kern Co., Cal., lands irrigated by river water, carrying sediment, gave 18 per cent. better results, after the fifth year of cropping, than lands irrigated by clear, artesian well water. Much other similar testimony is given.

The canal lines and dam proposed are thus described: The dam and head works are located in a gorge about 10 miles above Boise City. The walls of the cañon are immense gravel banks, capped with basalt and resting on basalt, which here forms the river bed. This basalt furnishes excellent material for the masonry of the head works, and will be used for the dam and backed with gravel and sand.

There would be six head gates to this canal, each 8 ft. wide by 24 ft. high, placed close to the south bank of the river, and adjoining them, on their north side, would be a similar gate extending to the bottom of the river, 8 ft. lower than the canal gates, and to be used for scouring purposes. By this arrangement the sand and gravel coming down the river in the flood season will be prevented from entering the canal, and can yet be scoured out at a proper time. The head gates are closed by roller curtains, on the general plan of the gates used in the slack water navigation of the Seine, and illustrated in our issue of Dec. 11, 1886, from drawings made by Mr. FOOTE. The piers separating the gates are 3 ft. thick and of the other dimensions shown in the side elevation given.

The dam, adjoining the scouring gate, will be about 41 ft. high, 10 ft. wide on top, with a front slope of 2 to 1 and back slope of 1 to 1, backed by sand and gravel, as shown. The dry face of the dam will be built of the loose basalt rock, dumped from the bluffs into the river and allowed to take its natural slope. When the dam is high enough, gravel will be dumped in on the upper side until the whole



**Canal on Mesa.**

is tight. The height of the dam is such that water is never to be run over the crest; and to prevent this a waste-weir, 500 ft. long and 8 to 12 ft. high, will be built on the basalt rock adjoining the dam.

All the masonry for the gate piers and waste-weir will be constructed of basalt rock laid in Portland cement. But the jambs and coping of the piers and the crest of the waste-weir will be built of granite, taken from a fine ledge within one-half mile of the dam. This masonry will all be built before the dam is commenced.

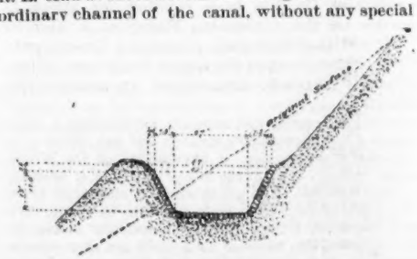
The canal, for the first two miles, will be built in the gravel bluffs of the cañon, which are quite steep, in places 25° from the horizontal. In order to reduce its cost as much as possible it will be made narrow and deep, as shown in the sections, and given a heavy grade. The sides throughout will be revetted with stone, and the bottom paved. The general dimensions of this two miles of canal will be 47 ft. wide on top, 27 ft. on the bottom, 17½ ft. deep, with a grade of 4 ft. per mile. This will carry 4,000 cu. ft. of water, with a depth of 15 ft., and a calculated velocity of 7.7 ft. per second.

At the end of the cañon section the dimensions of the canal will change to 90 ft. wide on top, 65 ft. at the bottom, 12⅛ ft. deep, and a grade of 2 ft. per mile. This will carry 4,000 cu. ft. of water 10 ft. deep, with a calculated velocity of 5.3 per second. These velocities are calculated from the formula,

$$V = 96.5 \sqrt{R S},$$

in which $V$ = mean velocity of water in ft. per sec.
$R$ = hydraulic mean depth.
$S$ = slope in ft. per foot.

Mr. FOOTE says he found this formula to give results agreeing very closely with the actual discharge of the Ganges Canal, as found by a vast series of measurements made by Capt. ALLAN CUNNINGHAM, R. E. And as these were made with great care in the ordinary channel of the canal, without any special



**Main Canal in Canon.**

conditions interfering with or changing the natural flow between common earthen banks, he considered these measurements a safe and accurate test for the formula. As the banks are made of heavy, coarse gravel, the velocity of 5.3 ft. per second is not too great for these banks to withstand; greater velocity in the Cavour Canal show no ill effects from this cause.

At the beginning of the third mile, just above the widening of the canal, will be placed a trap and small gate. This trap is a trench cut in the bottom of the canal, and running diagonally upward across it from the gate. In this trench all small stone and sediment that may be loosened from the high banks by spring thaws will be caught and pass out of this canal through the gate. Mr. FOOTE notes the remarkable conformation of country which permits

*A legal miner's inch, in Idaho Territory, is that quantity of water which will flow through an inch square orifice in an inch partition, with a pressure, or head of water, extending 4 ins. above the center of the orifice. Forty-eight of these miner's inches equal 1 cu. ft. per second. In twenty-four hours this miner's inch will discharge 1,300 cu. ft. of water, which is a "twenty-four-hour miner's inch," and is the kind used in this paper, unless otherwise designated. The term appears to have originated as an *oncia*, in Piedmont, Italy, about the middle of the sixteenth century, was first adopted in this country in the placer mines of Georgia, and afterwards throughout the West Coast, both for mining and irrigation. It has many different values, depending upon the head, size of orifice, etc., the most common, perhaps, being a 6-in head, above an orifice 2 ins. high, delivering 45.0 cu. ins. per second, or 2,250 cu. ft. in twenty-four hours. One cu. ft. per second equals 38.4 6-in. miner's inches, or 48.0 Idaho miner's inches. (From Mr. FOOTE's report.)

large canal, 30 miles long, to be constructed across the natural drainage courses of a country with practically no expense except that of excavation; and in the whole line of the canal there is but one piece of rock-cutting, of inconsiderable amount.

## PERSONALS.

Mr. WM. LEE, Assistant City Engineer, Hyde Park, Ill., has resigned.

MR. C. A. ALDERMAN has been elected City Engineer of Eau Claire, Wis.

Mr. GEO. A. FARLOW has been elected President of the Cincinnati, Sandusky & Cleveland.

MR. GEO. D. BAKER, of Cincinnati, has been appointed City Engineer of Dunkirk, N. Y.

Mr. FRED J. H. RICKON, M. Am. Soc. C. E., has been re-elected City Engineer of Little Rock, Ark.

GEN. THOS. L. CASEY, Chief of Engineers, U. S. A., has been elected a member of the National Academy of Sciences.

MR. FRANK HUBBARD, C. E., of Kingston, Ont., died April 11. He was engineer of construction of the Kingston & Pembroke Ry.

MR. CYRUS G. FORCE has been elected City Engineer of Cleveland, O., vice Mr. W. P. RICE. Mr. FORCE has occupied this position before.

COL. HENRY FLAD, past president Am. Soc. C. E., was, on April 19, confirmed by the United States Senate as a member of the Mississippi River Commission.

Mr. PROSPER W. SMITH will retire on May 1 from the position of Treasurer of the Oregon Ry. & Navigation Co., and will be succeeded by Mr. JAMES G. HARRIS, Treasurer of the Union Pacific road.

Mr. CLEM HACKNEY, formerly Superintendent of Machinery and Motive Power of the Union Pacific Ry., has been appointed Vice-President and General Manager of the Union Standard Journal Bearing Co., of Chicago.

Mr. M. A. ZOOK has been appointed Engineer of Maintainance of Way of the Indianapolis and Chicago division of the Louisville, New Albany & Chicago road, with headquarters at Indianapolis. Mr. ZOOK was for some time Engineer of Maintenance of Way on the Indianapolis & Vincennes road.

MR. THOMAS G. NOCK, President of the New York Locomotive Works, in Rome, N. Y., died in that city April 20, aged 61 years. He was born near London, England, and came to this country when a child. In 1854 he became superintendent of the E. G. Ripley Iron & Steel Works, at Windsor Locks, Conn., which position he held until 1864. In 1864 he went to Rome and assumed the superintendency of the Rome Iron Works, which he retrained until 1881. At that time he became instrumental in organizing the locomotive works company, and was elected its president.

Mr. JOHN VAN NORTWICK died at Batavia, Ill. April 15. He went to Kane Co., Ill., in 1837, and was largely interested in railway building, having been Chief Engineer of the Galena & Chicago Union Ry.; also of the Chicago, Burlington & Quincy. When the latter road was extended to Burlington and Quincy he was made President, and held the office for eight years. He built flour mills, paper mills, and pulp mills, and was a large owner of water-power lands in Wisconsin. He was originally chief of the corps of engineers employed on the canals of this State.

## PUBLICATIONS RECEIVED.

—*The Camden Mountains on the Coast of Maine.*—With 60 illustrations by Wm. Goodrich Beal. 56 pp. 7½x5 ins. paper covers. Price 25 cents. Lee & Shepard, Boston, Pubs.

A summer resort guide book. The illustrations are so pretentious that they ought to be better. Why an old publishing house should attach its name to a pamphlet like this passes comprehension.

—*Revised Pocket Geologist and Mineralogist;* or, sixteen chapters on Coals, Oils, Ores and other Minerals for Practical People, etc. By Frederick H. Smith, Engineer and Geologist. 1890. Published by the author at 227 E. German St., Baltimore, Md. Price, $1. Pocket-book form, 204 pp.

This is one of the handiest and most useful additions to the engineer's library, for service in the office or in the field, that has lately come to our notice. It is a revision to date, in pocket-book form, of the author's "Pocket Geologist" of 1877, and his "Rocks, Minerals and Stocks" of 1882. The text is concise but clearly expressed in the plainest terms, so that all may understand, and certain touches of humor crop out in it in unexpected places that decidedly add to its practical value. This pocket-book is, of course, not intended to be a scientific treatise of the subjects discussed; but it contains abundant data for the very great majority of cases coming under the observation of possible users. As an indication of its contents we give the sixteen chapter heads, as follows: Bottom Facts and Bed Rocks; Coal Measures; Oil and Gas; Iron and Maganese Ores; Gold and Silver Ores; Copper and Tin Ores; Lead and Zinc Ores; Nickel, Cobalt and Chrome Ores; Antimony, Mercury, Platinum, etc; Gems and Precious Stones; Ornamental and Building Stones; Cements and Clays; Salts and Fertilizers; Mineral Paints; Grits and Spars; Other Valuable Minerals. Under each of these heads the mineral is clearly described, and, in all cases, its gravity, hardness and composition given, together with other useful information. The book is, in fact, "just what is wanted" by a multitude of engineers, and should be welcomed accordingly; as we have no doubt it will be.

## SOCIETY PROCEEDINGS.

**American Railway Master Mechanics' Association**—The members having voted by a large majority in in favor of holding the next annual convention at Old Point Comfort, Fortress Monroe, Va., the Executive Committee have arranged to hold the meeting there. The Hygeia Hotel has agreed to accommodate those attending the convention at $3 per day. Those desiring to secure rooms in advance should address F. N. Pike, Hygeia Hotel, Fortress Monroe, Va., before the opening day of the meeting, June 17. President Briggs has appointed Messrs. Wm. Garstang, T. W. Gentry and A. J. Cromwell as a committee to make arrangements for the convention.

**Engineers' Club of Cincinnati.**—At the regular March meeting of the club three new members were elected and one application for membership presented. The date for holding the regular meeting in April was changed from the third to the fourth Thursday. The paper prepared and read by Col. Wm. E. Merrill comprised an extended review of the history, extent, development, conduct and cost of the construction and maintenance of the inland navigable waterways of France, which include 3,000 miles of canals, 2,050 miles of canalized rivers, and 1,850 miles of rivers that are used for purposes of navigation, all of which, with slight exception, are under the direct management of the government.

J. F. WILSON, Secretary.

**Engineering Association of the Southwest.**—Meeting held at Louisville, Ky., on April 11, President John MacLeod, of Louisville, presiding, and 25 members and 20 visitors in attendance. A very cordial address of welcome to the Association was made by Col. Bennett H. Young, of Louisville, and letters of regret were read from Chas. D. Jacobs, Mayor of Louisville, and Edward Maguire, Captain of Engineers, U. S. A., recently transferred to Louisville.

A communication was read from Mr. Wm. P. Shinn, Chairman of the Committee of the American Society of Civil Engineers on the revision of its Constitution relative to the matter of Proposed Forms of Affiliation of Local Engineering Organizations with the American Society of Civil Engineers, requesting this association to formulate its views and submit them by either report or by personal representation at a meeting of the Committee of the American Society at New York in June, 1890. The matter was referred to the Executive Committee of the Association with instructions to report at the May meeting. The program of the evening was introduced by a paper entitled, "Excavating under Pneumatic Pressure," by Mr. Charles Hermany, Chief Engineer of the Louisville Water Co., Louisville, Ky. The paper comprised a brief historical outline of the development of the present forms of excavating under pressure with descriptions of the various devices employed. The paper gave particular attention, however, to a description of the construction and workings of the O'Connor excavating bucket, which Mr. Hermany had found very succeful in the sinking of his immense pneumatic cassion for the foundations of the new pumping station in the bed of the Ohio river at Louisville. The device consists of a cylindrical bucket working in a cylindrical shaft that extends from the open air above to the working chamber of the caisson with the bottom of the shaft closed and access to it given through air tight doors in its side near the bottom. The upper end of the bucket, which is closed at top and bottom and has openings at the side to correspond with the openings in the shaft, is fitted with an extension or flange which forms a conical air tight valve the seat of which is attached to the shaft and is of sufficient diameter to permit the whole bucket, except the top forming the valve, to pass freely through. To operate the system the bucket is lowered until the valve seats itself. The lower portion of the shaft is thus shut off from communication with the open air by the conical valve forming the top of the bucket. The air pressure in the caisson is then turned on to the portion of the shaft below the valve, the doors in the side of the shaft opened and the operation of filling the buckets through these doors and the corresponding openings in the side of the bucket is effected. When ready to be hoisted the doors entering the side of the shaf are closed, the air pressure in the lower portion of the shaft is released and the bucket is hoisted out of the shaft. While the lower portion is under pressure the bucket valve is held to its seat against the upward air pressure below the valve by three conical pointed screws that pass through the shaft and hold down the valve against its seat. When the bucket is to be hoisted these are backed out of the way.

The second paper of the evening, entitled "Foundations of the Louisville and Jeffersonville Bridge," which is now under construction, was read by the engineer in charge, Mr. Robert L. Engle, of Louisville, Ky. The structure will be a single track railway bridge, with 5-ft. sidewalks on each side, and street traffic will be carried over by trains of flat cars, with suitable railings and gates, a platform being built at each end of the bridge to allow teams to drive on and off. This arrangement is similar to that now in effect at Omaha, Neb., and a similar plan will be employed on the new Merchants' Bridge at St. Louis, soon to be opened for traffic. Beginning at the Jeffersonville side, the bridge entire comprises an iron viaduct approach, 4,073 ft. in length, with a maximum grade of 0.9 ft. per 100, then one span of 210 ft. in length, one of 550, one of 553, one of 550, and two of 341, closing with the Louisville approach, which will be an iron viaduct 2,740 ft. in length, with a grade of 1.2 ft. per 100, making the total length of iron work a little over 1¾ miles. The bridge will have no draw span, as the lowest point of the substructure will be 53 ft. above high water and 92.3 ft. above low water. Counting from the shore end of the 210-ft. Jeffersonville span, piers Nos. 1, 6 and 7 will be composed of ⅝-in. iron shells filled with concrete, No. 1 resting on rock, and Nos. 6 and 7 resting on pile foundations. Nos. 2, 3, 4 and 5 will be masonry piers composed of dimension face-stone with concrete backing. No. 2 was built on bed rock in an open coffer dam. No. 5, which is now completed to high water, was sunk to 44 ft. below low water, by pneumatic caisson and a crib, and is the pier at which the accident occurred on Jan. 9, by which 14 workmen lost their lives by the escape of the compressed air from the caisson. Nos. 3 and 4 will be sunk similarly to No. 5, though as yet no work has been done on them except to build the caissons which are now floated and waiting for the river to fall. Sooysmith & Co. are the contractors for the substructure. Both the papers of Mr. Hermany and Mr. Engle, with their drawings, will be published by the association at an early date. The discussion of Mr. Engle's paper drifted into a discussion on concrete and hydraulic cement, in which the cause of the setting of the cement was discussed. On motion of Mr. E. C. Lewis, Messrs. Olin H. Landreth, William L. Dudley, and Granville W. Shaw were appointed a committee to report on the present state of knowledge relating to the cause of the setting of cements and mortars.

The programme for the following day's entertainment of the Association was then read and an invitation extended to the Association by the Louisville Southern Railroad to pass over its line and inspect its new high bridge at Tyrone, Ky. The Association then adjourned to meet at Nashville on May 8. On Saturday, the 12th inst., the Association was very pleasantly entertained by the resident members, aided by the proprietors and managers of the leading industrial establishments and railroads centering in Louisville. They were taken by the elevated road to visit the Kentucky & Indiana bridge and the Louisville bridge. They were then driven in carriages through the tornado district and were then taken to inspect the Louisville Water Co.'s pumping station, the water tower of which was entirely demolished by the recent tornado. The excursion stopped on the way to inspect the substructure work of the new Louisville and Jeffersonville bridge, and while returning were given a lunch on the train. The remainder of the afternoon was spent in a trip to the Crescent Hill reservoir, the storage plant of the Louisville water system. While at the latter point the association was called to order in the gate house, and the following resolutions were adopted: Resolved by the Engineering Association of the Southwest that the thanks of this body be tendered to the Kentucky & Indiana Bridge Co., the Jeffersonville, Madison & Indianapolis R. R. Co., the Louisville & Nashville R. R. Co., the Galt House Co., Mr. R. L. Engle, the Louisville & Jeffersonville Bridge Co., Mr. Charles Hermany, and the Louisville Water Company, for courtesies extended to the association during its meeting in Louisville, Ky. After adjournment the visiting members assembled and adopted the following resolutions: *Resolved*, That the visiting members of the Engineering Association of the Southwest extend to the local members of the association their sincere thanks and express their hearty appreciation of their kind entertainment and the courtesies extended while in Louisville.

**Western Railway Club.**—At the meeting on April 15, the discussion on the proposed Chicago Joint Defect Card, which was presented at the last meeting, (see ENGINEERING NEWS, March 29, p. 299), was continued. A good deal of opposition to the plan was developed, it being thought by several that the adoption of the proposed system would cause confusion, and conflict with the M. C. B. rules.

A paper was read by W. H. Lewis, Master Mechanic of the Chicago, Burlington & Northern R. R. on "Counterbalancing Locomotives." The following is slightly condensed from the paper as presented:

In order to analyze the problem as clearly as possible we will at first deal with the revolving weight independent of the reciprocating weight.

Starting with the problem of balancing the revolving weight, we will present the proposition that the counterweight be so located, and be of such weight that the revolving weight be balanced in a state of rest, with the crank in any position.

Acknowledging this self-evident proposition, it follows that the counterweight must be located with its center of gravity exactly opposite that of the revolving weight or crank; also, that, according to the principles of leverage, the weight of the counter weight and the weight of the revolving parts must be inversely proportionate to their respective distances from the center of axle as fulcrum of lever.

In other words (as per Fig. 5), the counterweight D multiplied by B, the distance from its center of gravity to center of axle must be equal to the revolving weight C, multiplied by A, the distance from its center of gravity to center of axle. Hence, as per Fig. 5,

$$A \times C = B \times D, \text{ and } A : B :: D : C.$$

*Example.*—The distance from the center of gravity of a revolving weight of 200 lbs. to the center of the axle is 12 ins., and the distance of the center of gravity of the counterweight of 100 lbs. is 24 ins., because

$$\frac{200 \times 12}{24} = 100 \text{ lbs. and } \frac{200 \times 12}{100} = 24 \text{ ins.}$$

If the foregoing conditions of static or stationary balance have been obtained, the development of centrifugal force as a result of rotary motion will also produce a dynamic or moving equilibrium, as will be seen by the following examples, according to the formula of centrifugal force, which is as follows:

$$\text{Centrifugal force} = \text{weight of body} \times \frac{(\text{veloc. in ft. per second.})^2}{(\text{radius in ft.}) \times \text{"G."}}$$

Suppose, as in the previous example, we have a crank a revolving weight of 200 lbs., with center of gravity at 12 ins. from center of axle, balanced by a counter weight of 100 lbs. with its center of gravity at 24 ins. from center of axle, the revolving speeds being 50, 100 and 200 revolutions per minute.

According to the formula above given we have the following result:

Centrifugal force of revolving weight and its counter weight at 50 revolutions per minute = 170 lbs.

*Example.*

$$\left.\begin{array}{l}\text{Velocity of counter weight in feet per second at 50 revs. per minute}\end{array}\right\} = \frac{50 \times 6.2832}{60} = 5.236 \text{ (ft. per second).}$$

Then

$$\left.\begin{array}{l}\text{Centrifugal force in revolv. weight at 50 revs. per minute}\end{array}\right\} = \frac{200 \times 5.236^2}{1 \times 32.2} = 170 \text{ lbs. in revolving weight.}$$

$$\left.\begin{array}{l}\text{Velocity of counterweight in ft. per second at 50 revs. per minute}\end{array}\right\} = \frac{50 \times 12.5664}{60} = 10.472;$$

Then

$$\left.\begin{array}{l}\text{Centrifugal force in counter weight at 50 revs. per min.}\end{array}\right\} = \frac{100 \times 10.472^2}{2 \times 32.2} = 170 \text{ lbs. in counter weight.}$$

Centrifugal force of revolving weight and its counterweight at 100 revolutions per minute (which is twice the above speed) would be found equal to $2^2 \times 170$ lbs. = 681 lbs.

In the same way the centrifugal force of the revolving weight and its counter weight at 200 revolutions would be found equal to

$$2^2 \times 681 = 2724 \text{ lbs.}$$

To balance the reciprocating weight we must have the same conditions of static balance existing between it and its counterbalance, which will appear in Figs. 1 to 4, where, in order to consider the force of gravity, an upright position of cylinder is assumed. It will be seen that a perfect static balance is obtained by means of the counterweight shown, with crank in any imaginable position.

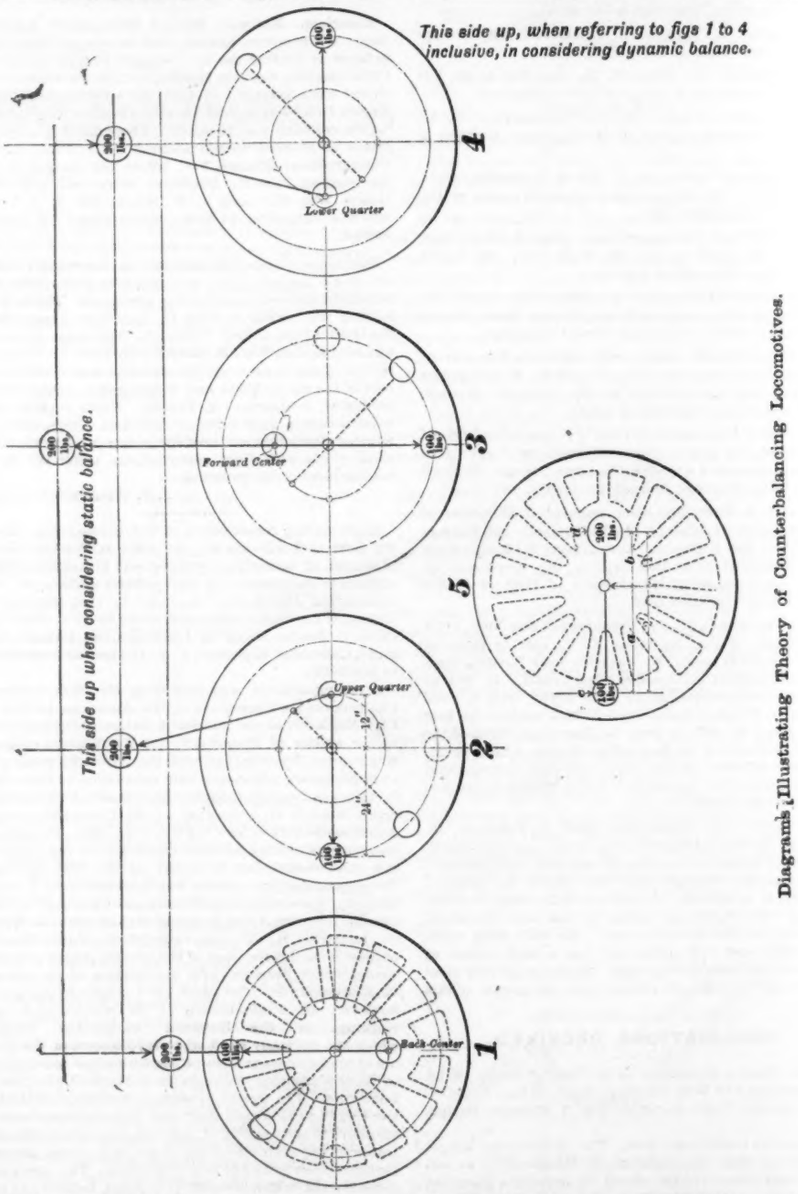
In this case we find, by reference to Figs. 1 to 4, representing a driver turning from right to left, that, at the forward and back centers we have a perfect dynamic balance, because at those points the uniform centrifugal force is all absorbed in overcoming the increased momentum of the reciprocating weight and in changing the direction of its motion. The arrows indicate the direction of the tendency of the reciprocating weight and its counter weight. In Figs. 2 and 4 we have the reciprocating weight and its equivalent counter weight moving in opposite directions, and the product of the square of their horizontal velocities, multiplied by their respective weights, are equal; hence, the horizontal balance is perfect, but the centrifugal weight of their counter balance is not counteracted by the reciprocating weight.

By the above it will appear that the reciprocating weight is perfectly balanced at all points by the revolving counterweight, but the counterweight is balanced by the reciprocating weight at the dead points of centers only. Hence, the effect of the revolving weight as applied to balance the horizontal action of the reciprocating weight is only to convert it to vertical force acting on the rail, producing what is termed a hammer blow.

Therefore, a solution of the problem will involve the choice of the lesser evil; that undoubtedly is the hammer blow, considering the smoothness of running and the durability of the engine and the comfort of enginemen.

As to the distribution of this counterweight for the reciprocating weight, it is evident that the time-honored custom of dividing this counterweight equally between connected drivers is not effective unless the effect of this counterweight can be uniformly transmitted to the main driver, which is a condition impossible to fulfil by means of the ordinary parallel rod, with the longitudinal play or lost motion, which it must necessarily possess or acquire in the course of time.

From the preceding it appears that the proper method of balancing the drivers would require that the counterweight of the main drivers be equivalent to the revolving weight added to the whole of the reciprocating weight.




Diagrams Illustrating Theory of Counterbalancing Locomotives.

(Revolving weight, including pins, hub and forward end of parallel rod and one-third of the main rod. Reciprocating weight, including the other two-thirds of the main rod; cross head, and piston and its attachments.)

This condition, of course, leaves only the revolving weight of the connected drivers to be balanced by its equivalent counterweight as per conditions above shown.

While the above statement is theoretically correct, my observation of the effect produced on tires on our engines leads me to believe that under certain conditions of speed the weights intended to counterbalance the reciprocating parts produce opposite results to those intended, and work considerable damage to the machinery of the engine as well as of the track. I have found that the tires invariably develop a flat spot at the point of contact with the rail when the left hand pin has just passed the forward center. You will perhaps ask why the same effect is not produced by the corresponding point on the back end of the stroke. I will explain this by saying that the point of contact of the periphery of the wheel with the rail is near the point of the center of gravity of the counterweights, and has a tendency to overcome or retard the centrifugal force; while in the former case, with the center of gravity on the upper quarter, it is free to exert a leverage acting in the same direction as the power applied from the cylinder, causing a slight slipping of the wheel.

It may be interesting to know to what extent the reciprocating weights may be ignored. I will say that in testing the balance of a modern engine that was built expressly for heavy passenger service, I find that the back wheels require 189 lbs. with the center of gravity 26 ins. from the center of axle. To balance the revolving weight one-half the side rod (960 lbs.) and half the forward wheels had only 368 lbs. of counterbalance with which to balance 908 lbs., as follows: main rod 315 lbs., half-side rod 160 lbs., cross-head 157 lbs., piston 276 lbs., total 908 lbs., or, in other words, the reciprocating weights were entirely ignored in the forward wheels, and the back wheels are 189 lbs. short of the proper revolving balance. These engines were in service nearly four years before the balance was corrected without known injury to the track.

I am free to admit that when all the various conditions of speed, power applied, effect of pressure in the cylinder, etc., are considered, it is to me a very perplexing problem as to just what portion of the reciprocating weights should be applied to the counterbalance. Let us consider for a moment the power exerted by a cylinder 18 ins. in diameter with an area of 254.46 ins., with a steam pressure of 45,624 lbs. acting in the same direction as the reciprocating weight. It seems to me that 600 lbs. of counterbalancing supplies an imperceptible resistance to its effect. In condensing my opinion on this subject I will say that it is impossible to distribute such portion of recip

rocating weight as will insure a uniform motion under the varying conditions of speed, power applied, and with engines running, as they are required to at times, without pressure of steam, ordinarily called "shut-off;" that if the revolving balance is perfect no injury is possible to the machinery or rails, and, while at high rates of speed the engine may develop a disagreeable, oscillatory motion, known as fore and aft, when shut

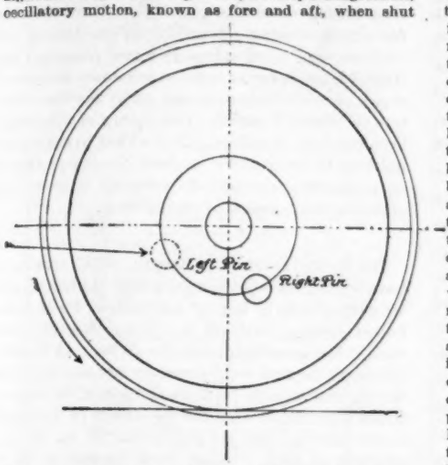



**Diagram Illustrating Effect of Excessive Counterbalance on Tire Wear.**

off the vertical or hammer-blow motion will be reduced to a minimum.

Mr. Lewis here presented the following figures showing change made by him in one engine and the balance in another.

ENGINE 150 (TEN-WHEELER; 56-IN. WHEEL CENTER).

Weights of Revolving Parts.

| | Front. | Main. | Back. |
|---|---|---|---|
| ½ front side rod | 107 | | |
| Middle connections | | 275 | |
| Back half main rod | | 293 | |
| | | 568 | |
| ½ back side rod | | | 134 |
| **Weights of reciprocating parts.** | | | |
| Front half main rod | | 216 | |
| Crosshead | | 165 | |
| Piston complete | | 303 | |
| Total weights to be balanced | 107 | 1,252 | 134 |
| Present balance | 107 | 630 | 110 |
| Former balance | 425 | 585 | 405 |

ENGINE 10 (EIGHT WHEELER; 63-IN. WHEEL CENTER).

| Weights of Revolving Parts. | Front. | Back. |
|---|---|---|
| Front half side rod | 121 | |
| Back half main rod | 157 | |
| | 278 | |
| Back half side rod | | 121 |
| Weights of Reciprocating Parts. | | |
| Front half main rod | 113 | |
| Piston complete | 255 | |
| Crosshead | 145 | |
| | 513 | |
| Total weights | 791 | 121 |
| Balance | 385 | 250 |

After reading his paper Mr. Lewis stepped to the blackboard and drawing the sketch shown herewith, said:

I wish to call attention particularly to the effect of excessive counterbalance on the wear of tires. All of our locomotives are counterbalanced with the full weight of the reciprocating parts, and we have found that our left-hand main tires universally develop a flat spot at the point of contact with the rail, with the driving wheel in the position as shown in the diagram.

We have at this point of the stroke the full pressure of steam exerted on the left hand pin in the direction as shown by the arrow and at the same time the center of gravity of the counterweights have so nearly reached the vertical point as to overcome the effect of gravitation, the inertia of which is exerting an impelling motion in the same direction as the power applied at the pin.

Mr. D. L. Barnes offered the following explanation of the flat spot being on the left hand side:

Possibly I can explain the cause of the flat spot being greater on the left hand side. It may arise from the fact that the right hand crank usually leads on American engines. This sketch shows the positions of the right hand crank pin at *O* and the left hand crank pin at *G*, with the counterbalance directly opposite the cranks, the left hand counterbalance being at point *P* and the right hand at *M* the direction of motion being as shown by the arrow, the engine moving ahead. *A* represents the connecting rods. In the position shown it will be noticed that the counterbalances on all four wheels are above the center of the wheel, and the centrifugal force of that portion of the counterbalance which is used to balance the inertia of reciprocating parts is in this position tending to lift the wheels from the rails. This, of course, would reduce the weight on the rails and induce slipping, which would cause flat spots at the point of slip. The position of the flat spot described by Mr. Lewis is on the left hand wheel where it is in contact with the rail when the left hand crank *G* has just passed the dead center, not quite as much as is shown in the sketch. At this time the balance *M* is higher above the center line than the balance *P*, and therefore the balance *M* is acting with greater force vertically, and tends to lift the right hand wheel more than the balance *P* tends to lift the left hand wheel. There is, therefore, greater weight on the left hand wheel at this time, and if the wheel be caused to slip, the wheel with the greatest weight thereon will be worn the most, and as the left hand wheel has the most weight, it might be expected that the flat spot would be greater on it than on the right hand wheel. There is still another reason why slip would be liable to take place at this time, and that is the cranks are in a position corresponding to one of the maximum turning moments. As a locomotive's drivers revolve, the turning effect by the connecting rods is variable, and during one revolution there are four points of maximum and four of minimum effect. The points of the maximum vary with the point of cut-off. The obliquity of the connecting rod for the left hand wheel is such at this time as to increase the pressure on the rail on that side, as at this time the left hand cylinder is working steam full boiler pressure, whereas on the opposite or right hand side the piston is working in expanding steam, and possibly against some back pressure. This point is well brought out by Mr. Lewis. If the right hand crank did not lead, but the left instead, then the greatest turning moment would take place when there was the greatest weight on the right-hand wheel. These arguments are somewhat speculative, but indicate a possible explanation of the occurrence of the greater flat spot on the left hand wheel as noticed by Mr. Lewis. In my own experience I have noticed four flat spots on each driver, some of which were larger than others; but I had not noticed that the maximum spots occurred on the left hand main driver, though I can see reasons why such might me the case.

Mr. Barr: If the drivers slip, why have not you got the flat spot on both wheels opposite, and why not on the back wheels as well as on the front wheels?

Mr. D. L. Barnes: I cannot tell you that; I know you will find it on all wheels.

Mr. Barr: If this flat spot is caused by a slip I do not understand why the back wheel does not show the same trouble. There is a tendency on some engines on the right hand side to show a flat spot where it passes the front center also.

I have here a few figures regarding a class of enginss that we have, which have given a great deal of trouble, and of which engineers complain very bitterly. We have two classes of ten-wheel freight engines, one with wheels 54 ins. in diameter over tire and the other 60 ins. The engines with 60-in. wheels give very satisfactory service,

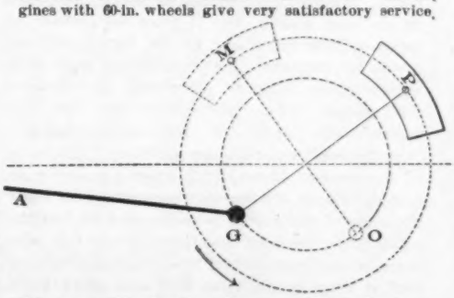



**Diagram Illustrating Cause of Flat Spots on Tires of Left Hand Drivers.**

and are run fast; the engines with the 56-in. wheels have been objected to seriously by the engineers, and I think with quite good cause. The figures I have here show the changes in the counterbalancing of one of these engines with 54 in. wheels. I submit them as illustrating an experiment that has given very satisfactory results. The engine is now running in service with the 60-in. driver engines, and so far as I have reports, the engineers would just as soon run that engine with 54-in. wheels as the engines with the 60-in. wheels, and they say it climbs a hill rather better.

CHANGES MADE IN WEIGHT OF RODS AND COUNTER-BALANCE ON ENGINE NO. 469.

| | *Old wt., lbs.* | *New wt., lbs.* |
|---|---|---|
| Main rods | 1170 | 900 |
| Side rods | 1344 | 858 |
| Front driver counterwight | 363 | 413 |
| Main " " | 395 | 819 |
| Back " " | 413 | 413 |

R. M. driving wheel's crank pin to be balanced as follows:

| | Lbs. |
|---|---|
| ½ weight of R. F. S. rod | 107 |
| ½ " main " | 300 |
| ½ " R. B. S. " | 108 |
| ½ " reciprocating parts | 230 |
| Estimated weight of crank, hub and pin | 120 |
| Main D wheel's counter-balance | 865 |

R. B driving wheel's crank pin to be balanced as follows:

| | Lbs. |
|---|---|
| ½ weight of R. B. S. rod | 108 |
| ½ " reciprocating parts | 230 |
| Estimated weight of crank pin and hub | 120 |
| R. B. D. wheel's counter-balance | 458 |

| | Lbs. |
|---|---|
| Engine No. 469 R. crosshead weighed | 172 |
| " " piston weighed | 362 |
| " " F. S. rod " | 214 |
| " " B. S. " " | 216 |
| " " main " " | 450 |
| " " crank hubs and pins weighed (estimated) | 360 |
| | 1,781 |

| The reciprocating parts are as follows: | Lbs. |
|---|---|
| Crosshead | 172 |
| Piston | 309 |
| ½ of main rod | 150 |
| | 691 |
| ⅓ of 691 lbs. | 230⅓ |

R. F. crank pin ought to be balanced as follows:

| | Lbs. |
|---|---|
| ½ of R. F. S. rod | 107 |
| ½ of reciprocating parts | 230 |
| Estimated weight of R. F. pin and hub | 120 |
| R. F. D. wheel's counter-balance | 457 |

The secretary here read a series of propositions concerning counterbalancing submitted by a member of the club.

The following statements which have appeared from time to time in the technical papers, and some which have not, are offered for debate:

*First.*—The best way to reduce the amount of counterbalance in locomotive driving wheels and its effect on the rail is to reduce the weight of the reciprocating parts.

*Second.*—The weight of the reciprocating parts of our locomotives are altogether too heavy as they now are made, and therefore all main rods should be made of I section, all crossheads should be as light as possible to make them without decreasing the wearing surface. Al pistons should be made of cast steel or wrought iron, very thin and dished in form, and piston rods should not be made larger in diameter or longer than is actually necessary. Further than this the stub ends of the main rod at the front should have the least possible amount of material therein consistent with strength.

*Third.*—The diameter of the driving wheels should be made as large as possible without reducing the hauling capacity of the locomotive, in order to reduce the effect of the counterbalance on the rail, it having been shown that an increase in diameter of wheel produces a considerable decrease in the effect of the counterbalance on the rail.

*Fourth.*—It is not as advisable to decrease the stroke as to increase the diameter of the wheel, because for the same loss of hauling capacity the increase in wheel diameter produces the greatest amount of reduction in the effect of the counterbalance on the rail.

*Fifth.*—If one high speed and one low speed locomotive be counterbalanced by the same formula the effect on the rail will be much greater in the case of the high speed locomotive for the reason that the effect of the balance on the rail varies as the square of the velocity of the locomotive. Therefore, it might be said:

*Sixth.*—That if the high speed locomotive can be run satisfactorily when balanced according to a given formula that a low speed locomotive can be balanced by a formula, which would give less total balance. In other words, the lower the speed the less the balance required, and the higher the speed the greater the balance should be.

*Seventh.*—It has been stated by several prominent civil engineers who are occupying responsible positions on Western railroads, that a locomotive can be run satisfactorily at high speed without balancing the reciprocating parts at all, and because such balance is damaging to the track it should be entirely removed. One railroad company has been experimenting with locomotives without counter-balance for reciprocating parts, but the results are not known.

*Eighth.*—There are now on record about ten cases in which the track has been badly damaged by high speed locomotives improperly counter balanced. These cases are on Western roads, and this will serve to show the necessity for a consideration of this subject by the Western Railway Club, and that it is in keeping with the custom of the club, which is to discuss only live topics.

The propositions were laid over for discussion at the May meeting. A few remarks made by Messrs. Rhodes, Barr, Barnes and Marshall, however, brought out the danger of running disconnected engines at high speed. Cases were cited where the effect of unbalanced counterweights in drivers, where a disabled engine was run in with one side disconnected, or where a new engine, entirely disconnected, was being hauled over the line in a high-speed train, had caused serious damage to track. With lighter reciprocating parts, as advocated in proposition two this danger would be lessened, as the counterweights would be lighter, but it was further argued that restrictions upon the speed of disconnected engines should be made, and Mr. Barr stated that such restrictions were now made on his road.

The subjects for the May meeting will be "Journal Boxes" and "The Counterbalancing of Locomotives."

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**Advertising rates. 20 cents per line** *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

**Drawings and Photographs** *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*


### COMING TECHNICAL MEETINGS.

**American Society of Mechanical Engineers.**—The annual meeting will be held in Cincinnati, O., in May. Secy., F. H. Hutton, 64 Madison Ave., New York, N. Y.

**Western Society of Engineers, Chicago, Ill.**—Next meeting, May 1. Secy., J. W. Weston, 230 La Salle St.

**Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.**—Next meeting, May 1. Secy., Clement March.

**Association of Civil Engineers, Dallas, Tex.** Next meeting, May 2. Secy., E. K. Smoot, Elm and Austin Sts.

**Engineers' Club of Philadelphia, Pa.**—Next meeting, May 3. Secy., Howard Murphy, 1122 Girard St.

**Civil Engineers' Society, St. Paul, Minn.**—Next meeting, May 5. Secy., Geo. L. Wilson, City Hall.

**Engineers' Club of Kansas City, Mo.**—Next meeting, May 5. "The Evolution of the Elevator," E. M. Sheridan. Secy., Kenneth Allen, 200 Baird Building.

**Civil Engineers' Club, Cleveland, O.**—Next meeting, May 6. Secy., C. O. Palmer, 22 Cedar Ave.

**Engineers' Club of St. Louis, Mo.**—Next meeting, May 7. "Compound Locomotives," A. T. Woods; "Granitoid Curb and Gutter," Otto Schmitz. Secy., W. H. Bryan, 309 So. 7th St.

**American Society of Civil Engineers, New York.**—Next meeting, May 7. Annual convention, at Cresson, Pa., in June. Secy., John Bogart, 127 E. 23d St.

**Engineering Association of the Southwest, Nashville, Tenn.**—Next meeting, May 8. Secy., Olin H. Landreth, Vanderbilt University.

**Civil Engineers' Association of Kansas, Wichita, Kan.**—Next meeting, May 14. Secy., J. C. Herring, Wichita.

**New England Railway Club, Boston Mass.**—Next meeting, May 14. "Length of Rigid Wheel Base Permissible on American Railways for Locomotives, Tenders or Cars." Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

**New York Railway Club.**—Next meeting, May 15. Rooms, at 113 Liberty St.

**American Water-Works Association.**—Annual meeting at Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

**Western Railway Club, Chicago, Ill.**—Next meeting, May 20. Rooms in the Phœnix Building. Secy., W. D. Crosman.

**Engineers' Society of Western Pennsylvania.**—Next meeting, May 20. Secy., S. M. Wickersham, Pittsburg, Pa.

**Boston Society of Civil Engineers.**—Next meeting, May 21. Secy., S. E. Tinkham, City Hall.

**Master Car-Builders' Association.**—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W. Cloud, Buffalo, N. Y.

**American Railway Master Mechanics' Association.**—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

If any reader of this journal knows of one or more well-authenticated instances in which a car has been set on fire in a collision or derailment by kerosene or other oil lamps containing oil of 300° or any other fire proof, or if any reader can learn of such an instance by inquiry among other railway officers, we shall be particularly obliged for a statement of the facts, which will, if desired, be treated as confidential, as respects the place and date of the occurrence. By diligent inquiry, extending over a series of years, we have not been able to learn of a single such instance. The information is desired for a technical comparison of the good and bad points of the various systems of car-lighting in the four items of cost new, photometric power, cost of maintenance and comparative safety, which we have in preparation, and which may run through several issues of this journal. Instances are also desired where cars have been set on fire by accidents to lamps, without any train accident, but less urgently, as these are known to have occurred, and in at least one instance with grave loss of life. It is suggested that the evidence must be very clear to show that lamps were the cause of fire, when stoves of any kind were also in use upon the cars.

In order to exhaust every chance of obtaining this information, this notice will be repeated for one or two issues.

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Whether well founded or not, the belief is wide-spread that kerosene lamps in cars do add sensibly to the danger of fire on cars, especially in case of accident, and this is good *a priori* evidence that the danger exists; but if there be any better evidence we do not know of it, and much desire to learn of it. One of the technical journals, whose statements are usually trustworthy, and which we cordially admit is conscientiously edited in such matters, has recently declared that it "remembered" of such an occurrence as having happened in the past season, but it gave no further or more definite reference to the facts; and we must be forgiven for remarking that such remembrance suggests somewhat the case of the student who "did know, but had forgotten" the cause of the aurora borealis. "Gentlemen," remarked the professor, "this is one of the greatest blows which science has ever received. There sits the only man who ever knew the cause of the aurora borealis—and he has forgotten it!" We trust that the only man who ever knew of a car being set on fire by lamps in an accident, if there be only one, will now speak up in meeting and give chapter and verse for his knowledge, or else forever hold his peace. We by no means assert that there are not dozens of such instances; the chances should be that there are, but should even one be found we will be compelled to admit that "we never heard of it till yesterday."

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Perhaps the worst instance of fire starting from a lamp without any train accident was that which happened on the Great Western Railway of Canada, Feb. 18, 1874. In that case a coach took fire from the falling of a lamp in the closet at the forward end. The bell-cord was, for some reason, not connected with the locomotive, and there was then no automatic brake to be applied from the coach, while there must also have been no car behind and a baggage or other car without windows in the end in front, or the trouble behind would have been seen. As it was, the train ran two miles or so with the car on fire before it could be stopped; the coach was entirely consumed and eight persons were suffocated or burned alive within it, while thirteen others sustained injuries in jumping from the train. Such an incident seems hardly possible now, however, first, because the bell-cord is rarely left disconnected; secondly, because the automatic brake furnishes a double check; thirdly, because car lamps are now so solidly constructed and attached that there is little danger of their falling unless torn away or thrown out in some train accident; fourthly, no accident of this kind can well occur except in a lone passenger car behind a baggage car without windows in the end doors, access to which is cut off by the flames before the alarm is raised. Distressing as this single accident was, therefore, it is of a kind so extremely unlikely to occur under modern conditions that it seems hardly necessary to consider it as a class affecting the question of car-lighting.

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The Revere accident of August, 1871, seems to have been aggravated more or less by the lamps, and we suspect it to be largely responsible for the prevalent feeling that oil lamps are dangerous on cars, if however high proof the oil be. At Revere, however, the fires were certainly not started from lamps, but by coals from the fire-box of the engine, which had buried itself for two-thirds of its length in the crowded rear car (containing 65 to 70 passengers) so that "valves were broken so as to permit of a free escape of scalding steam, while coals from the fire-box were scattered among the *débris*, and coming in contact with the fluid from the broken car lamps kindled the whole into a rapid blaze. The remaining (three) cars were jammed and shattered, and, though the passengers in them escaped, the oil from the broken lamps ignited, and before the flames could be extinguished the cars were entirely destroyed."* The result was 29 killed and 57 injured, all the deaths and most of the injuries being in the last car, and the further result was a general regeneration of New England railway practice, which was then inexcusably backward, neither the Westinghouse brake, nor Miller platform, nor telegraphic train orders, nor (we may well believe) well constructed metal lamps filled with carefully inspected high-proof oil, being in use. In fact, as Mr. Adams says, "the disaster was not due to any single cause, but to a combination of causes, implicating not only the machinery and appliances in use by the company, but its discipline and efficiency from the highest official down to the meanest subordinate." The same spirit of cross conservatism which is now blocking the way to the introduction of automatic brakes and couplers in New England, was then rampant as to all the devices mentioned. But it does not appear in the evidence as to this accident that the lamps either started any fire, or caused the loss of any life or property which would otherwise have been saved, although it does seem clear that the lamps helped to spread the fire, and so might have caused loss of life. We know of no later instance telling so directly as this against the use of oil lamps for lighting.

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The *Locomotive Engineer*, of this city, takes wrongful exception to two statements in our article of March 15 on the Hamburg disaster. It says, first, in reference to our suggestion that an engineer on the alert could have released the brake even after application from the cars, so that only a momentary check at most would have occurred:

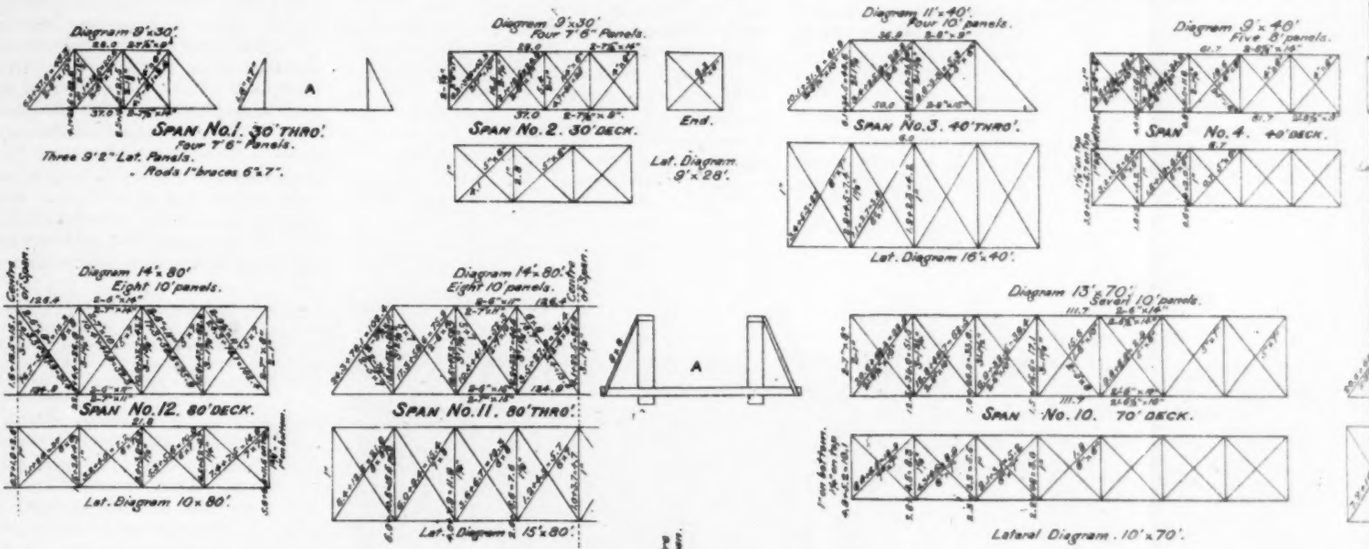
> The engineer could not release the brake in *any* length of time unless the conductor's valves in the car was closed—if the brake was applied from there. The only way to release the brake is to establish a pressure in the train pipe *greater* than that in the brake cylinders; and it is plain that this cannot be done when a valve is open, or there is any other opening from the train pipe to the atmosphere.

Our contemporary forgets that there are two kinds of conductor's valve, both of which have their advocates, and both of which are largely used. One of them, the older form and the one still

*Railway Accidents, by C. F. Adams, Jr., pp. 139-40.

# HOWE TRUSS BRIDGES, OREG

## STRAIN SHEETS AND SIZE OF MEMBERS FOR BRIDG



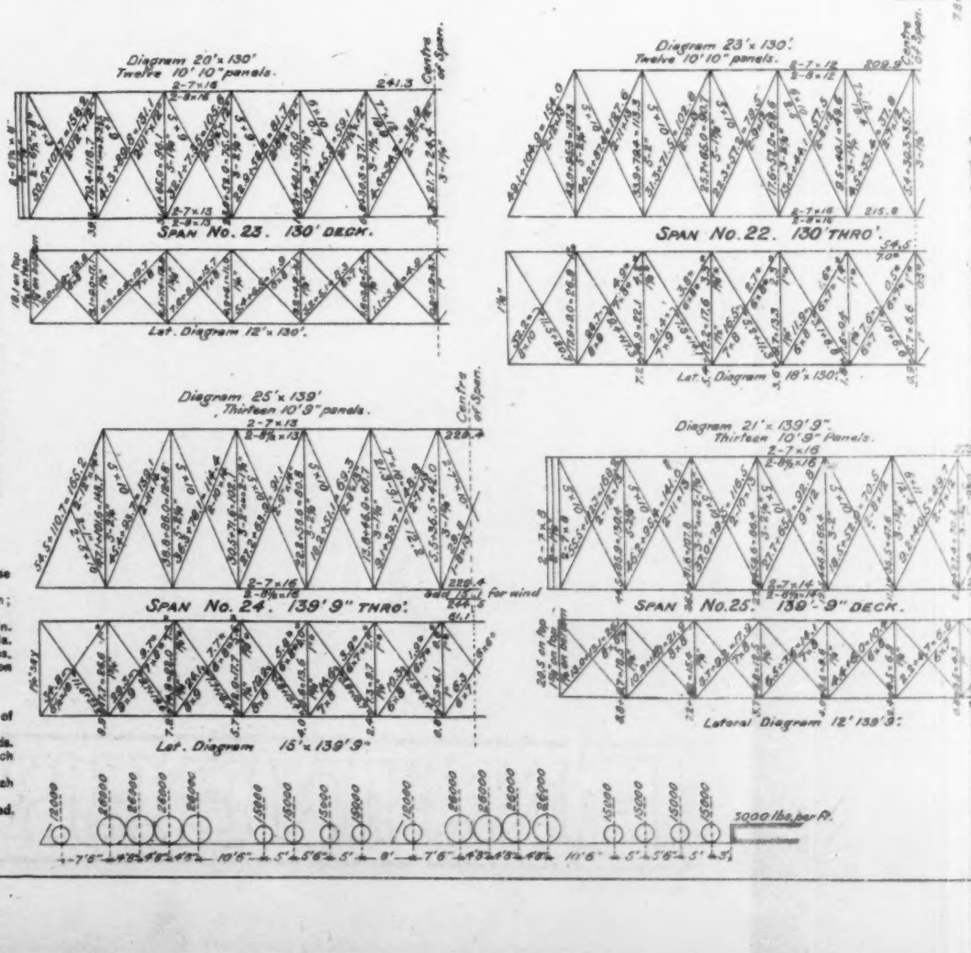

### TABLE OF DATA

| No. of Span | Assumed loading per ft. | | | Total load per ft. lbs. | Estimate of Quantities | | | W. Iron lbs. Rods upset |
|---|---|---|---|---|---|---|---|---|
| | Trusses lbs. | Floor lbs. | Train lbs. | | Timber Ft. B.M. | W. Iron lbs. | C. Iron lbs. | |
| 1 | 360 | 500 | 5,060 | 5,920 | 10,165 | 2,170 | 970 | |
| 2 | 360 | " | 5,060 | 5,920 | 6,750 | 1,930 | 1,210 | |
| 3 | 400 | " | 4,600 | 5,500 | 13,358 | 2,960 | 1,070 | |
| 4 | 400 | " | 4,600 | 5,500 | 9,362 | 3,380 | 1,550 | |
| 5 | 450 | " | 4,300 | 5,150 | 19,023 | 5,610 | 2,880 | |
| 6 | 450 | " | 4,300 | 5,150 | 12,561 | 4,710 | 2,830 | |
| 7 | 540 | " | 3,860 | 4,900 | 22,785 | 6,790 | 3,660 | |
| 8 | 540 | " | 3,860 | 4,900 | 20,709 | 5,900 | 3,830 | |
| 9 | 600 | " | 3,640 | 4,740 | 29,931 | 9,260 | 5,260 | 8,210 |
| 10 | 600 | " | 3,640 | 4,740 | 27,617 | 8,430 | 7,980 | 7,610 |
| 11 | 620 | " | 3,600 | 4,720 | 35,388 | 11,660 | 9,790 | 10,260 |
| 12 | 620 | " | 3,600 | 4,720 | 32,764 | 10,190 | 9,730 | 9,190 |
| 13 | 720 | " | 3,560 | 4,780 | 42,709 | 15,170 | 12,530 | 13,440 |
| 14 | 720 | " | 3,560 | 4,780 | 41,883 | 17,820 | 12,960 | 15,150 |
| 15 | 720 | " | 3,560 | 4,780 | 40,690 | 13,220 | 12,710 | 11,820 |
| 16 | 800 | " | 3,500 | 4,800 | 48,892 | 22,580 | 14,290 | 18,950 |
| 17 | 800 | " | 3,500 | 4,800 | 46,454 | 18,040 | 13,990 | 16,040 |
| 18 | 880 | " | 3,400 | 4,780 | 54,767 | 25,820 | 15,930 | 22,290 |
| 19 | 880 | " | 3,400 | 4,780 | 50,295 | 19,400 | 14,950 | 16,320 |
| 20 | 940 | " | 3,300 | 4,740 | 62,038 | 30,890 | 18,290 | 26,020 |
| 21 | 940 | " | 3,300 | 4,740 | 59,834 | 23,080 | 16,320 | 19,580 |
| 22 | 1,000 | " | 3,200 | 4,700 | 70,128 | 37,050 | 20,830 | 30,180 |
| 23 | 1,000 | " | 3,200 | 4,700 | 66,779 | 27,930 | 20,460 | 23,360 |
| 24 | 1,050 | " | 3,150 | 4,700 | 78,156 | 40,890 | 23,210 | 33,090 |
| 25 | 1,050 | " | 3,150 | 4,700 | 76,323 | 32,640 | 23,260 | 27,360 |
| 26 | 1,100 | " | 3,100 | 4,700 | 86,632 | 48,090 | 27,060 | 39,140 |
| 27 | 1,100 | " | 3,100 | 4,700 | 86,053 | 39,630 | 27,140 | 33,390 |

Strains given are for one truss, and in 1,000 lbs.
Sections " " " " " " (rods assumed not upset).
Loads in above table are for two trusses.
Strains are those due to dead load + maximum from moving load.
Assumed live loads are intended to fully equal (in strains produced) those given in diagram below.
Load on a floor beam, 14,000 lbs. on a panel length of chord as a beam; 36,000 lbs. on an axle.
Wrought iron in tension, 10,000 lbs. (net section at root of thread) per sq. in.
Wood (in compression only) 1-6 to 1-8 of breaking load by Smith's formula.
Wood (in tension only) usually 800 lbs. to 1,000 lbs. (500 lbs. to 800 lbs. in shortest span) per sq. in.; and as packed beam maximum section (net section) 800 to 1,000 lbs.

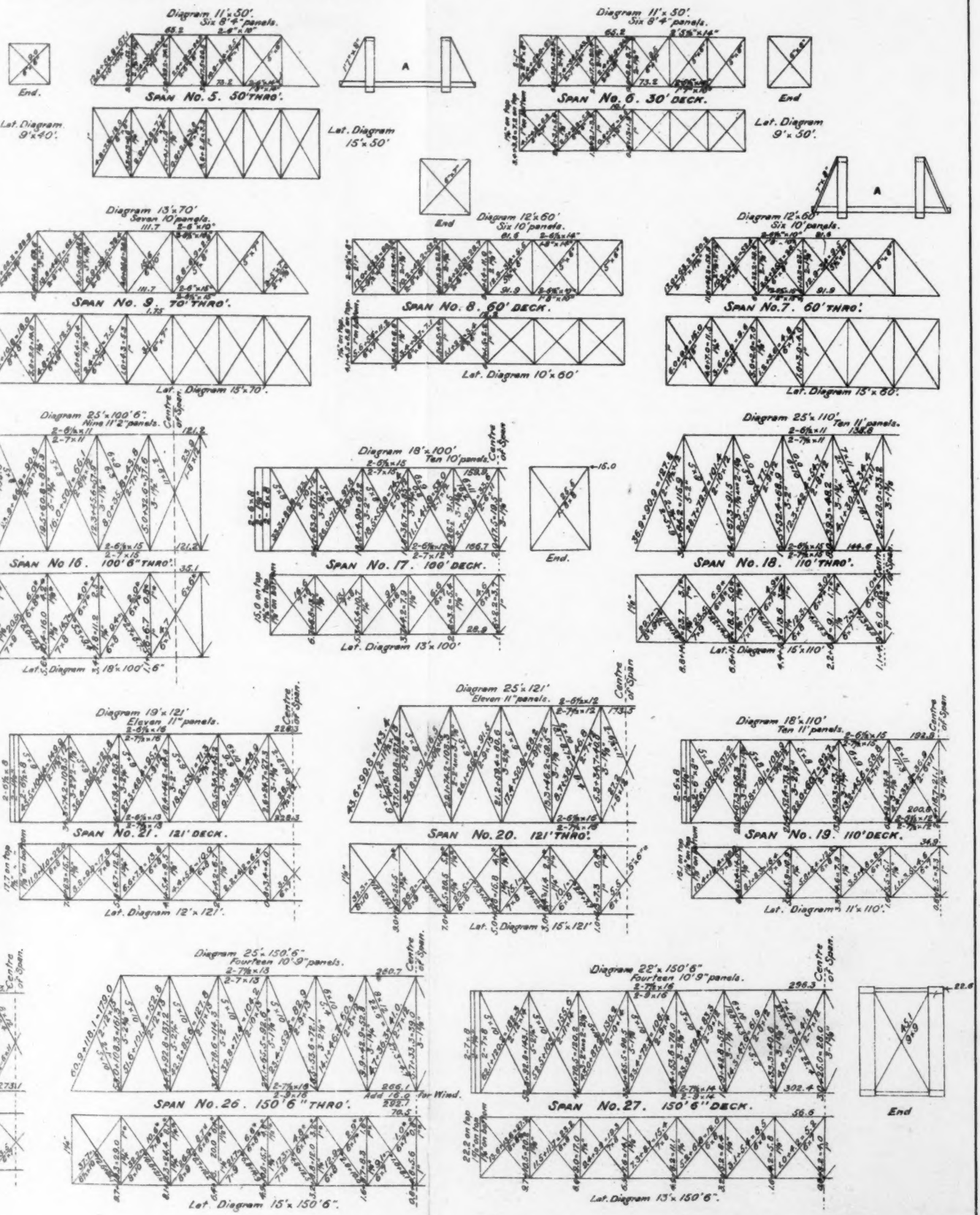
### LATERAL SYSTEMS.

DECK SPANS—A uniform load of 150 lbs. per ft. (each system), ⅓ of it at feet of rods.
A moving load of 150 lbs. per ft. (each system), all of it at feet of rods.
Sway braces at each panel assumed to equalize the strains so that each system is the same (except end rods).
THROUGH SPANS—A uniform load of 150 lbs. to 200 lbs. per ft. (each system). A moving load of 300 lbs. per ft. (lower system).
Iron 13,000 to 15,000 lbs. per sq. in. net. Timber 1-4 to 1-5 breaking load.



# GON PACIFIC RAILROAD.

## DGES FROM 30 FEET TO 150 FEET SPAN.




ARCHIBALD A. SCHENCK,
CHIEF ENGINEER.

CHAS. HART & SONS. LITH., 36 VESEY ST., N. Y.

most largely used, stays open only so long as held open. On its release it becomes instantly possible for the engineman to release brakes in the usual way. The other style is a plain cock, which, if once opened, stays open until closed by hand. We understand that this last style was *not* in use in this case, but whether it was or not makes no difference, because the facts are that in the Lake Shore disaster the engineer failed to place his brake valve on lap when the conductor's valve was pulled open, and so lost all the air from the main reservoir through his own valve. He was, therefore, clearly in fault in any case, since he had no right to assume that the conductor's valve would be left open, even if it was not of the self-closing type.

Our contemporary also asserts, with much confidence:

> It was impossible to release those brakes, when set at Dunkirk by the first break, without (restoring the pressure in the train pipe, or) bleeding out *all* the air in the brake cylinders and auxiliary drums. So long as there was a pound of air in the auxiliary drums and the train pipe was open, the brakes would set.

There is a little appendage to the brake-gear known as the "four-way cock," which our contemporary has apparently forgotten, but which makes the above statement untrue. We did not assume this four-way cock to have been used, for as a matter of fact, nothing that we said is inconsistent with our contemporary's statement. What we did say was that there was much air left in the auxiliary reservoirs after the first break, which might have been utilized for braking, except for the train pipe being open to the atmosphere; but that, as it was, it was necessary to "bleed" each car separately. We did not assert that after this bleeding there was any air pressure left. We may add that while in theory "a pound of air" will work the brakes, as a matter of practice it takes a very considerable pressure to work them at all.

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THE deepening of the Welland Canal by the Canadians and the possibility of introducing "twenty British gunboats" of 14 ft. draft into the great lakes thereafter, is being used for all it is worth as an argument in favor of a canal between the Mississippi and Lake Michigan. Commercially, the Illinois, the Niagara or any other ship canal would be useful, if the cost was in any degree proportionate to present and future advantages. But all of these schemes should be discussed on their real merits without introducing a possible war with England as the ruling element. Forts and heavy modern guns along the stretch of the St. Lawrence, between the Thousand Isles and Cornwall, would seriously interfere with the passage of British gun-boats up that river; and on the lakes we now have a powerful navy of ships of 3,000 tons and upward, only requiring an armament of rapid-fire guns to compete with any English gun-boat that could pass the Welland Canal. War between ourselves and Great Britain is a very remote contingency, and one that we trust will never be realized; but in case this should be the unhappy fact, the quickest way to remove the Welland canal as a troubling factor in the controversy is—to take it. If we quit bothering about remote war possibilities and attend strictly to business, in ocean and lake shipbuilding and the extension of inland and foreign commerce, we will provide for all contingencies that the future may bring us.

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A RECENT publication of the New York Meteorological Bureau, showing by isothermal lines the normal average temperature of the summer months in all parts of the State, reveals at once why Hudson River real estate is not more in demand, and why the beautiful country seats which line its banks so often come upon the market at low figures The Hudson River valley is by much the hottest part of the State. There is a perfect basin of heat at Troy and Albany, with sharp ascent from it in all directions. There is a comparatively cool part of the Hudson right opposite the Catskills, the temperature there being two or three degrees lower than at Albany or New York; but with that exception the summer temperature of the Valley is substantially the same for its whole length, and from 2° to 8° hotter than in any other part of the State. In July, for example, most of the Hudson Valley averages 74°, while twenty miles back from the river, and then west for three-quarters of the area of the State, the average is 66° to 68°, the rest of the State, along the lake shore and Genesee Valley, being only 70°. It is perfectly natural that no country-seat, however beautiful, should be permanently attractive when its summer temperature is so much higher than can be found in almost equally attractive regions, either north or south, and either east or west. The difference between 90° in the shade and 82° to 84° is a very important one.

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### The City of Paris Disaster.

We note with satisfaction that whenever and wherever any notable engineering event occurs, some subscriber to ENGINEERING NEWS is increasingly likely to be on hand at the critical moment, and give us the benefit of his observations, as does Mr. ROBERT GILLHAM, of Kansas City, Mo., in the long and interesting letter on the *City of Paris* disaster, which appears in another column. Mr. GILLHAM chanced to be a passenger on the *City of Paris*, and to have just been critically examining the engines, and had only returned to the saloon from the engine room when the break-down occurred. His account is the best, and, in fact, the only one which has yet appeared, recording the facts of the disaster from an independent engineering standpoint.

From our London correspondent, who has made an inspection and photographs of the engine-room since the arrival of the ship at Liverpool, we have also received a communication full of interesting details, the substance of which, however, we can best give in editorial form. Neither photographs nor engravings of the broken machinery have yet reached this country, but from all the descriptions received the engine-room resembles nothing so much as pictures of a heap of old iron in a junk yard, as described in Mr. GILLHAM's letter.

Describing his visit, Mr. DUNNELL says: Nothing so complete in the way of a breakdown has ever before been seen. Every part of the machinery of the starboard engine seems to be bent, twisted or broken, as if by explosion of dynamite.

The information thus made available respecting the accident is not of a very assuring kind to the ordinary Atlantic passenger. It was supposed by the general public that this vessel and her sister ship, the *City of New York*, were only to be sunk by such a calamity as being ground between a couple of gigantic icebergs or some such cyclopean effect. The builders or owners, or both, gave some delightful champagne lunches about the time of the launch, and most roseate accounts of the safety, elegance and comfort of these ships appeared in the daily press, more especially the safety, which was "fully assured" under any remotely probable combination of circumstances by the numerous bulkheads. The papers then were very learned in the matter of naval architecture and marine engineering, and were full of information, the only peculiarity about the accounts being the strong family likeness that existed between those of the different organs, which, to a person cynically inclined, might have suggested a common parentage. Matters are very different now, we are told, and if the ubiquitous newspaper reporter puts his nose inside a certain office, where he was erstwhile so smilingly received, he gets—well, certainly no information. Secretiveness is the distinguishing characteristic of Anglo-Saxon officialism, whether it be the officialism of a big company or a public department, and we find the British Admiralty allowing itself to be judged utterly incompetent, it not corrupt, rather than make public the cause and results of some comparatively trifling defects which have manifested themselves in recent war ships. Those interested in the *City of Paris* are now suffering a like martyrdom to their ancient traditions; for nothing in the realm of actual fact could be much worse than the fiction of some correspondents of British newspapers, who have had to rely on their imagination for their facts, if not on their memory for their wit.

The general facts of the case, so far as they have been made public, are now well known to our readers. When a short distance from the coast of Ireland one of the cylinders "went to pieces," to quote the official report of the captain of the vessel. This had the effect of "injuring the bulkhead, and breaking the injection and water-pipe connections, allowing a considerable quantity of water to enter both engine rooms." This is a very mild way of describing the rush of water that must have taken place to reduce the ship to a helpless and all but sinking condition in so short a space of time. Further investigation has shown that it was the low-pressure cylinder of the starboard engine that "went to pieces." The first impression was that the "cylinder had burst," and indeed the earlier reports used that expression. The bursting from internal pressure of a cylinder 9 ft. 5 ins. in diameter and over 5 ft. internal length could not fail to cause extreme havoc to the structure of the vessel, doubtless, breaching her skin and any bulkhead in the vicinity. But as a matter of fact cylinders do not burst explosively. The requirements of rigidity compel more than ample strength to withstand the stress of steam pressure, and when cylinders are injured it is generally through some of the working parts becoming loose or detached.

No room for doubt remains that this was the case in the present instance. Mr. GILLHAM's account corresponds exactly with that of a correspondent of our English contemporary *Engineering*, who says that a few seconds before the accident—

> There was a sound as if an eccentric strap or a smaller piece of machinery had parted, and the next sound was a crash as though the cylinder head had blown out, and later, falling, crushing and grinding sounds . . . Later I learned that the starboard engine room was flooded, and the low-pressure cylinder in its collapse and fall had demolished its condenser; that the injector outboard delivery pipes, with their Kingston valves and sea cocks, had been destroyed . . . and that the bulkhead between the two engine rooms had been cut through by the flying parts of the engine.

This description might be applied in every detail to the frequent cause of mishap in marine engines, especially when bolts are not made with a plus thread, namely, the breaking of one of the bolts that hold together the crank-pin brasses. The bottom ends of the connecting rods in the *City of Paris'* engines do not show any deviation from ordinary practice. Once set free the crank-pin from the brasses, and the rest of the phenomena described would follow. If the breakage occurred at the bottom of the stroke the piston would fly with inconceivably great force to the top of the cylinder, but the valve as long as it was worked by the other cylinders would continue to admit steam. The "falling, crushing and grinding noises" would be a necessary concomitant of the general break up of the engine due to the unarrested motion of the piston or the possible jamming of the loose big end between the still revolving crank and the base plate. Each set of the *City of Paris'* engines has 6 cast steel columns (3 at the back and 3 in front) of rectangular section, and split at the bottom to give lateral stability. The condensers are separate from the engines, "man-o'-war style." There is also a good deal of naval style about the design generally.

We have lately heard a great deal about the want of metal in some of the most recent designs

both for ships and engines, which have received the approval of the English naval authorities; and it may be that the Clydebank yard, where the *City of Paris* and its engines were built, had become imbued with the mania for lightness. The gentleman who presided over the destinies of the shipyard department was himself a government man originally, and had the reputation of designing one of the lightest torpedo vessels ever put afloat. However this may be, no possible design of engine could stand a 9-ton piston with a 5-ton piston rod, 2½-ton crosshead, and a 7½-ton connecting rod (for these are the weights of the respective parts), suddenly cast loose from their work and allowed to thrash about at their own sweet will, at a piston speed of 900 ft. per minute or 90 revolutions.

It may be, however, that the disconnection occurred at the crosshead, one of the bolts giving way there. In that case the destruction would perhaps be more speedy. Each set of engines has a bed-plate of cast steel, formed in three parts, each part weighing 16 tons. The present writer remembers witnessing the havoc that may be caused by the breaking away of a connecting rod in this manner during a trial trip of a torpedo boat he once made in Narragansett Bay, and he can easily imagine how quick would be the destruction caused by a similar accident on so grand a scale as in the *City of Paris*. The engine room floor is but 4 ft. 6 ins. from the bottom of the ship, and as the stroke of the engine is 5 ft., it will be seen how soon a hole might be punched clean through if the thrashing and plunging of the 7½-ton connecting rod once broke down the bed plate and columns. The precise course of events in the disaster is not likely to ever be known, but from the latest telegraphic reports it seems most probable that the brass lining of the propeller shaft split and gradually ground away, the chips from the brass cutting out the lignum vitæ bushing, thus letting the shaft "flop about" so as to throw enormous strains on the whole mechanism. The latter part of this process must, of course, have been rapid, or the danger would have been discovered in time and guarded against.

It now appears certain that the water was admitted by rupture of the great 20-in. induction pipe; but however the water get in, and whatever was the first cause of the accident, it is very evident the *City of Paris* and the thousand odd souls on board her, had a very narrow escape, for had the weather been a little worse the ship could hardly have failed to have gone to the bottom. In fact, it had a fairly narrow escape as it was, owing to weakness of the bulkheads, which was one of the most serious revelations of the accident. The *City of Paris* has fourteen transverse bulkheads, thus dividing her into fifteen compartments. The machinery department has also a fore and aft bulkhead, all doors being supposed to be on the upper deck above water line. None of the compartments exceed 35 ft. long, and the quantity of water they hold to the water-line is 1,250 tons, or, to the upper deck, 2,250 tons. Any two of these compartments could be filled without the flotation of the vessel being destroyed.

These precautions against sinking sound excellent, and are far in excess of anything found on former vessels of the class. It is at great sacrifice that these numerous bulkheads are placed in the vessel; perhaps at too great a sacrifice, as will be seen presently. But bulkheads, to be of use for saving a ship, must be of sufficient strength to withstand the pressure of water due to the head caused by flooding the compartment. We have had the correctness of the naval architects' calculations proved as to the reserve of flotation if two compartments were filled, for the longitudinal bulkhead between the engine rooms was broken down, but it would seem that a little extra roughness of the sea might have caused another bulkhead to give way. Our correspondent's letter in another column shows clearly that the chief source of peril was the athwartship bulkhead forward of the engine room. *It exhibited a pulsation of 4 ins. backwards and forwards, and shifted 2 ins.* We are not quite sure what the latter expression means, but the words we have put in italics are quite sufficient to show the want of stiffness in at least one bulkhead of the *City of Paris*. By aid of shores composed of spars, however, the bulkhead stood sufficiently long to save the ship and get it to Queenstown.

It is of little use, however, for the naval architect to provide bulkheads of whatever stiffness and strength (little good, that is, for saving the ship, although any kind of bulkhead may serve to satisfy the authorities) if these bulkheads are not kept intact by those in command of the vessel. Mr. GILLHAM is silent on this vital point, but a correspondent to the *Times* writes to give his experience of the sister ship, the *City of New York*, and says:

> There was a door way in the bulkhead between the two sets of engines, the key of which was supposed to be in the hands of the chief engineer, and which was to be used in emergency only. I have seen that door open at sea, and it is pertinent to ask whether the corresponding door in the *City of Paris* was open when this accident occurred. Further, it has often been asserted by experts that it would be impossible to work the ship without two communications in the transverse bulkhead between the engine room and boilers, and I have, when at sea, passed through that bulkhead in the *City of New York*, not through a door way, but through an opening made by the removal of a plate.

It is certainly a most difficult thing to work engines with doorless bulkheads up to the main deck. Perhaps the only practical step is to allow doors to be fitted, keep them shut as much as possible, but to organize a drill, to be often carried out, for closing water-tight doors in case of emergency. This is what has been done in the British navy with every appearance of success.

In the meantime the *City of Paris* is now laid laid up for what must certainly be very "general repairs." In spite of all efforts, the leaks through the 20-in. pipe could not be stopped until the ship reached port. This strongly suggests that it would be wise to have a diver form part of the crew of big mail steamers, as in the case of vessels belonging to the British navy. This does not mean any considerable extra expense, but only that there shall be one man who understands diving in the crew.

Among the lessons to be learned from this disaster, and which it is to be hoped will be learned, are the following:

1. The water-tight compartments and bulkheads, as constructed in the *City of Paris*, were beyond question the most important element in keeping the ship afloat after the accident. The weakness of these bulkheads came near sinking it. Greater care should be exercised in building bulkheads, securing greater strength to resist the weight of water pounding against them when compartments are filled with water, and the sea rough, making also all connections of every description absolutely water tight, allowing no openings of any kind in bulkheads.

2. The mechanical appliances for receiving and discharging cargo, manipulating the steering apparatus and anchors, and securing other mechanical results, should under no circumstance be concentrated and primarily operated wholly from the engine rooms, without equally efficient auxiliary means arranged for use in other parts of the ship. This was a very grave defect of the *City of Paris*, which, under the United States shipping laws, would have been impossible. An amendment to the British shipping laws requiring the pumps at least to be above the water-line and have an independent steam supply should be made.

3. No less than one pump for two compartments should be required, or, if the pumps are below the water line, one pump for each compartment, so arranged that they will each pump the water from two compartments.

4. To further protect the engine and boiler compartments against the possibility of similar accidents to the one in question, and avoid paralyzing the engine and boiler power of the ship by flooding, the engine and boiler compartments should be provided with means for making them air-tight, so that they could be closed when emergency demanded, and filled with compressed air, thus forcing the water out until the injury was repaired; or, if necessary, the men and machinery might operate under a sufficient air pressure to exclude the water until relief could be secured. Access could be had through air locks, and the air compressed by ordinary compressors properly located. Provision of this kind would not be expensive and should be exceedingly effective. An occasional drill would make the whole crew understand it, and had it existed on the *City of Paris* we should not have had the absurd spectacle of a great steamer with a 7,500 H. P. engine and 15,000 H. P. boilers, all in perfect working order, but unable to use them because the engine could not be got at.

There can be no doubt, however, that the *City of Paris* proved herself an immensely strong ship in this disaster. She went through an ordeal which is quite without parallel, and would have sunk any ordinary steamer, without any injury except to one engine room. The twin screw plan is not discredited. Had it not been for the breaking in of the bulkhead between the engine rooms there is no doubt the steamer would have made port with the port engine, as it was uninjured.

## Railway Construction in the Eastern Canadian Provinces.

We publish on another page a sketch map and detailed list showing the progress of railway construction in the Provinces of New Brunswick and Nova Scotia. According to this list there were 244 miles of track laid during the calendar year of 1889, and there are now 143 miles of railway in process of construction, 559 miles surveyed and under survey, and 433 miles projected with a fair prospect of being constructed in the near future. This somewhat surprising showing speaks well for the enterprise and growth of a portion of the Dominion generally looked upon as a somewhat barren, arctic country. The chances for development are, however, as great here as in almost any portion of the Dominion. Both Provinces contain large tracts of fertile land, well adapted to the growth of the hardier cereals, fruits and vegetables, as well as rich deposits of coal, iron and gypsum. The waters of the bays of Fundy and Chedabucto, the Strait of Northumberland, and the Atlantic along the eastern coasts of Nova Scotia and Cape Breton Island are rich in nearly all of the most important food fishes. Nearly all of the lines shown upon our map are being built to develop one or the other of these industries.

Taking up the provinces separately, we find considerable activity in Cape Breton Island. The recently completed Cape Breton Ry. and the Inverness Ry., now under construction, are designed to open up the rich fields of bituminous coal in Inverness and Cape Breton counties. These lines, together with the projected line from Louisburg along the south coast of the island, will have to depend mainly upon the coal traffic and the transportation of the products of the Cape Breton fisheries to Halifax for their income.

In Nova Scotia the most important new roads are the Western Counties, the Hants Central, the Stewiacke Valley & Lansdown, and the Nova Scotia Midland. The Western Counties Ry. Co. is constructing a connecting link between Digby and Annapolis, 20 miles long, connecting its own lines with those of the Windsor & Annapolis Ry., and thus completing a through line from Yarmouth to the Gut of Canso. The Hants Central and Stewiacke Valley & Lansdown railways will together shorten the line between the

Windsor & Annapolis and the Intercolonial railways, and penetrate a fine agricultural country. The Nova Scotia Midland will form a more direct line between New Glasgow and the Intercolonial Ry. and the fisheries of Chedabucto Bay.

In New Brunswick the most important lines are the Short Line extension of the Canadian Pacific Ry., from Harvey to Salisbury, and the Grand Trunk extension of the Temiscouata Ry. from Edmundston to Perry's Mills. Both of these lines have been surveyed and will probably be constructed. Among the other enterprises the completion of the Central R. R. of New Brunswick north to a connection with the Intercolonial Ry., at Doaktown, and south to St. John, is the most important.

Although beyond the limit of our map, it may be well to call attention in this connection to the projected railways which are to penetrate the bleak island of Newfoundland. These lines are being built by the government and comprise a narrow gauge road from Placentia Junction to Hall's Bay, 260 miles long, and a branch from Clark's Beach to Brigus, 12 miles long. Bids for the construction of these lines are now being advertised for. The route of the main line is nearly directly east and west, passing through the most highly developed agricultural section of the island, and entering the rich copper regions south of Notre Dame Bay and the coal and iron ore fields in the region of St. George's Bay. It is principally to develop these mineral lands that the road is being built and from which it will derive its principal income.

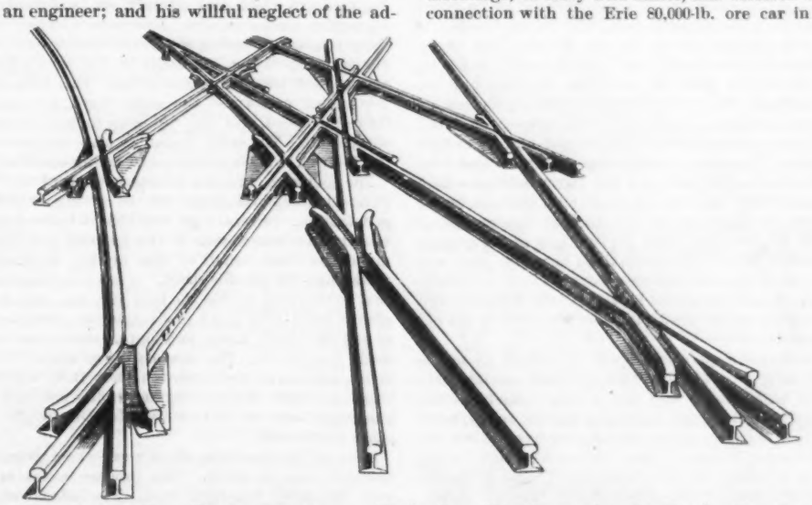
Taken as a whole, the railway development of the eastern Canadian Provinces compares very favorably with that of any other section of British North America, and a corresponding development in all industries is sure to follow.

## The Responsibility for the Walnut Grove Dam Disaster.

In our editorial of March 8, on the failure of the Walnut Grove Dam, in Arizona, we included the name of Mr. W. H. BATES, of this city, among those chiefly responsible for the insufficiency of the waste-weir, and for faulty design generally. From the letter of Mr. BATES to the Prescott *Courier*, elsewhere given in this issue, and from other information, we are now convinced that we unwittingly did Mr. BATES an injustice in regard to his control of design or execution. In commenting on the confused press reports in our editorial, we stated that: "If the dam really stood for three hours with water pouring over the crest, as reported, it really withstood an unusual test for a dam of this nature; and the lack of adequate discharge for flood water, rather than the construction of the dam, must be regarded as the cause of the disaster." The letters of Messrs. BATES and CHURCH fully confirm this opinion, and though Mr. BATES does not refer to the jamming of the 5 ft. square waste-gate in the bottom of the dam, commented upon by us, Mr. CHURCH does speak of "defective, unmanageable flood-gates" in a manner that convinces us that the condition of this gate was as stated in our editorial. It is now a question, however, whether even the discharge from this gate would have been of any saving value, when the smallness of the waste-weir and the exceedingly rapid rise in the flood level are considered.

It seems that Mr. BATES, though not claiming any knowledge as an engineer, was early convinced of the necessity of more ample discharge for flood water; and it was through him that Mr. CHURCH, while in that country on other business, was asked to visit the dam and give his professional opinion on this point to Mr. VAN BUREN, the financial backer and actual local manager of the work. This advice was disregarded, or only acted upon when too late. We also now learn that Mr. BATES sufficiently appreciated the problem presented to earnestly insist upon the services of thoroughly competent engineers in the construction of this dam; and while his advice and arguments were again disregarded, he should have the full benefit of his suggestions, prompted as they were by a study of the river itself, and the apparent necessities of the case.

When the present evidence is sifted down, we find we were quite right when, on March 8, we said that, "When the truth is told it will be found that the dam was practically designed and constructed by laymen, and not by engineers at all; and that the disaster is the natural result of this foolish tinkering with a problem, the possibilities and dangers of which were not appreciated." In this case one man, and his family, practically furnished the large sum of money expended upon this dam and its outlying works, about $800,000 in all and by virtue of this moneyed control this man also assumed that he was competent to manage it as the engineer as well. With too many of his class, well meaning but totally ignorant of the true dimensions of the problem involved, he thought that "any fellow" could be an engineer; and his willful neglect of the advice of his associates has cost him about one year's income out of an enormous estate, and has cost others all that they had—property and life. It is to be hoped that Mr. VAN BUREN has learned his lesson; and if he rebuilds the dam, as it is reported he will, that the work will be done throughout under competent engineering supervision.



**A Complicated Four-Track Crossing. Made by the Pennsylvania Steel Co. for the New York, Providence & Boston R. R.**

## Notes by Rail.

[EDITORIAL CORRESPONDENCE.]

### A COMPLICATED CROSSING.

A number of illustrations have recently appeared in ENGINEERING NEWS showing achievements of various firms in putting in complicated work in frogs and switches. The accompanying illustration shows a little achievement in this line of the Pennsylvania Steel Co. It is a four-track crossing, built for the New York, Providence & Boston R. R., and placed near the engine house at Providence, R. I. The two tracks passing away to the left in the cut are curves of 12° and 12° 30′, converging and crossing at an angle of 4° 47′. These two tracks are crossed by two tangents, which pass away to the right in the illustration, and cross each other at an angle of 7° 10′. The angles of the frogs used in this crossing are as follows: 4° 47′, 25° 40′, 17° 30′, 24° 34′, 19° 22′, 24° 27′, 7° 10′, 23° 10′, 15° 31′, 15° 36′, 17° 28′, 17° 34′, 9° 26′, 15° 28′ and 13° 19′.

### ALTOONA AND THE PENNSYLVANIA RAILROAD SHOPS.

As I turned over the leaves of the Altoona Directory I was amused to notice that the book starts off with a list of the officials of the Pennsylvania Railroad. Then follows the State Government of Pennsylvania and then the United States Government. The compiler was quite right to put the Pennsylvania Railroad ahead of both the National and State governments, since that corporation has vastly more to do with the affairs and the welfare of Altoona than either Uncle Sam or the Commonwealth of Pennsylvania.

The Pennsylvania Railroad Company has pursued the let-alone policy at Altoona, as regards the general control of the city affairs, and the results seem to have been as good, perhaps in some respects better, than at Pullman, Ill., where the citizens have comparatively a small voice in their local government. At Altoona many of the city offices are held by workmen in the shops, and the city seems on the whole to be pretty well governed.

The city has had a phenomenal growth, from 3,600 in 1860, to nearly 30,000 at the present time. This number may be considerably increased by the shops which are now being put up for the building of new locomotives, and which will require a considerable addition to the force at present employed.

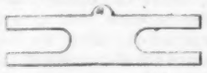
### THE LOCOMOTIVE SHOPS.

As I went into the erecting shop, one of the first things I saw was the heavy frame of iron beams for one of the 100,000 lbs. capacity cars, built for the Roeblings, to carry wire cables, and referred to in connection with the Erie 80,000-lb. ore car in last week's ENGINEERING NEWS. It may occur to some one that it is taking needless pains to build such a heavy special car for carrying wire rope. Instead of winding a cable on only two reels why not wind it on three or four, and put each on an ordinary car. At first sight it seems as simple a matter to wind a wire cable on three reels as on two. After one has pondered on the problem for a while he is apt to conclude it is not quite so easy.

Many who attended the last Master Mechanics' Convention at Niagara Falls will remember how the matter of driving boxes was taken up there. The report of the able committee favored a solid bronze box, but the convention in its discussion paid little attention to the report of the committee, and only one or two of the members seemed to have an idea that the solid bronze box was a possibility of the future. It is, perhaps, true that for a road which has to pay 7 or 8 per cent. for its capital the solid bronze box is more expensive than a cast-iron box. But a large proportion of American roads now pay but 3 or 4 per cent. on their bonded debt, and are constantly reducing their interest rate. On such roads it is very certain that the large first cost of a solid bronze box will be offset by the saving in fitting up and keeping in repair, and in its cool running under heavy loads. It may not be generally known that the Pennsylvania is equipping all its standard passenger engines with a solid phosphor-bronze box, and over 100 engines are now running with them. These boxes weigh about 350 lbs., but their large first cost is a permanent investment, since when the box is worn out it only needs remelting and the addition of a few pounds of new metal to make a new box.

The company is using a plain cast-iron piston with two cast-iron packing rings, weighing about 220 lbs. for a 20-in. cylinder. This seems an enormous weight to be jerked back and forth three or four hundred times per minute. Certainly, the need for a lighter piston has not been appreciated as it should be, or there would be greater effort to design a piston of some material stronger in proportion to its weight than cast-iron.

Cast iron packing rings are used on all pistons, and a new form of joint is being experimented with, the invention of M. F. GUTIERREZ, a machinist in the company's employ. It is a small piece of bronze



of the shape shown in the accompanying sketch, of the same width as the ring. The ends of the packing-ring are made to fit the slot in the end of the joint piece, and a small groove is made in one side of the spring ring groove to receive the projection *a*, on the bronze joint piece. It is thus impossible for the ring to change its position, so that the joints in the two rings will come opposite each other. Engine 648 had one piston fitted with rings jointed in this way, which ran 13½ months, while the piston on the other side used up eight rings jointed in the ordinary way, with plain beveled ends, in the same time.

The diamond stack, which but a few years ago was well nigh universal on American locomotives, has about disappeared from the Pennsylvania. It is still standard on the Tyrone division, but everywhere else the straight stack, with a plain moulding at the top, is used on passenger engines, and the rather ugly but serviceable flaring stack is used on freight engines. In the matter of pilots, too, a difference is made between the freight and passenger engines, the former being fitted with a low iron pilot with horizontal bars and the latter having a high wooden pilot, much handsomer, and, perhaps, better suited for knocking off live stock at high speeds.

In the erecting shop the last one of the engines wrecked in the Johnstown flood nearly a year ago was receiving the finishing touches. It is practically a new engine, however, the frames and cylinders being about all that was left of the old machine.

In the rod department I was interested to notice how large a part of the finishing which was formerly done with planer and file is now done by emery wheels. Not enough pains is generally taken, however, to separate emery wheel work from other departments, it seems to me. It is not enough to put it in a corner of the room, but it should have a separate room, unless a better provision for removing the dust is made than is generally the case.

A very commendable way of finishing side rods has been largely adopted here, which is not to finish them at all, but to leave them as they come from the hammer except finish at the ends. A consideration of the alterating strains in a parallel rod at high speed must convince anyone that to leave the skin of the iron on is an excellent way of increasing the rod's strength. A special machine in the rod shop is used for boring solid-end rods. It is merely an upright frame with two vertical boring spindles attached to move apart or together according to the length of the rod to be bored.

Some rather difficult pieces of forging have lately been turned out in the shape of some wrought iron Janney couplers for putting on the front ends of engines in place of the old bull nose, which even when heavily braced is rather light for the work which the Pennsylvania requires of pusher engines on its heavy grades.

In the foundry I was surprised to find how largely the small hand-molding machines have displaced hand labor. They are certainly highly successful. Four of these are in use in the brass foundry, and in the iron foundry there are three brake-block machines, one standard stake pocket, one truss-rod bridge, one bumper-block, two oil boxes, and one brake wheel ratchet, the last making four different castings from one pattern by simply changing the centers. With one of these machines two men can make 124 flasks per day. The use of these machines saves the making of 250,000 dry sand cores per year. The use of these machines was begun nearly eight years ago, and they have grown in favor from the first. The saving comes not only through the economy of labor in making the castings, but in the better quality of work turned out. The present foundry is inadequate to do the work required of it, and considerable work has to be given to outside shops. The invariable difficulty in doing this is in the quality of the work. Most founders look upon their trade as a rough and inaccurate one, and do not think it worth while to take the pains to turn out smooth castings of uniform size. It costs little more to make an accurate casting from what it costs to make one with ¼ in. variation here and there from the correct size, but many founders do not seem to appreciate that the greater accuracy is worth striving for.

Some special tools have been put in for placing the lead lining in brasses, by which a lead coating only $\frac{1}{64}$ of an inch in thickness is secured at a total cost for labor of 1½ cents per brass. The machine for boring brasses is operated at a cost of 1⅝ cents per brass.

A tool which is commended as saving much labor and waste is Wood's cross-head pulling device. Great trouble is often experienced in pulling piston rods from cross-heads, and it takes often some pretty heavy blows with a sledge, which are liable to injure the centers, before they will start. With the Wood device the piston rod is slacked back by a wedge without injuring the centers, and only a few blows of a light hammer are required.

In the erecting shop I saw a novel application of a C. & C. electric motor to to a Pedrick & Ayer boring machine which was at work on the cylinder of an engine under repairs. Everyone who has used these convenient boring machines knows how tedious is the operation, especially to the man with an aching back who turns the crank. This little electric motor performed the same work at several times the speed, and did not stop to rest or make complaints. The same motor is also used to turn the Pedrick & Ayer cylinder-end facing machine.

The Belpaire fire-box is now standard on the Pennsylvania, and seems to be giving excellent satisfaction. Several new wrinkles in boiler design were pointed out to me. It is a general practice to make the inside shell of the fire-box of thinner metal than the outside sheet. It has been suggested that to this may be due the fact that the stay bolts almost invariably break just inside the outer sheet; at any rate both inner and outer sheets are now made $\frac{5}{16}$ in. thick. The stay bolts are spaced 5 ins. apart, and are of such a section that their working strain is 12,000 lbs. per sq. in. Boiler pressure on passenger engines is now 160 lbs. On freight engines it is 140 lbs.

In one of the machine shops a car-wheel grinding machine was at work. This process seems to be very favorably regarded here. The labor cost of grinding is about 23 to 28 cts. per wheel. I suppose many engineers are inclined to look somewhat doubtfully on this grinding process, especially for new wheels, since it takes off the outer surface of the chill, which is supposed to be the hardest. No doubt, if a wheel could be cast to the exact shape and size to which it can be ground, it would wear somewhat better if this outer skin were left on. I suspect, however, that the difference is small, after all, between the hardness of the metal next the chill and the metal at a depth of ¼ in. or so, for I am told that many wheels make a larger mileage after their third grinding than after their first. Whether it is not better to cast wheels so true at the start that they will not need grinding may be questioned; but it is at least certain that the grinding process makes possible a new lease of life for wheels which otherwise should go to the scrap-heap.

Everybody is, of course, interested to know what results the Pennsylvania has secured from its experiments with the Webb compound engine, which was imported from England some fifteen months ago. Very careful tests have been made, which will probably be made public in a few weeks. The engine is now being repaired in the Jersey City shops, and the English engine driver who came over to run her has returned to his native heath. It is safe to say that the Webb compound will not be duplicated by the Pennsylvania. With all respect to the genius of her eminent designer, the locomotive is simply not suited to American traffic requirements.

But the Pennsylvania has by no means given up the compound engine. Drawings have already been made in the mechanical engineer's office for a new 2-cylinder compound, which is expected to be ready for service in about 3 months. The cylinder diameters will be 19 and 27 ins., with 68-in. drivers. The valve gear will be an adaptation of the Stephenson link, which the designers feel confident will prove better adapted to the compound than any of the more intricate types. Whether the new engine succeeds or not, the mechanical officers of the Pennsylvania are to be congratulated on their enterprise in undertaking independent work in this field where so much has already been done.

I was much impressed everywhere at Altoona with what I may call independence of thought, something which is by no means too common in railway mechanical work. When it does occur it is very apt to be mere old fogyism, the disposition to reject innovations and other's work and opinions on the mere ground of novelty and their contradiction of established prejudices. But, at Altoona, there seems to be honest independence and a disposition to go to the bottom of things. As a notable example of this I might mention several patented articles on whose reported adoption by the Pennsylvania Railroad, much stress has been laid by those interested in them. Certain inventors have, at various times, described to me the ecstasy with which their revolutionizing devices were greeted by the Altoona officials. It will be enough to say that on talking with these officials, I found them by no means overflowing with enthusiasm concerning these devices, and as ready to criticise their defects as to commend their excellent features.

This is as it should be. There are too many places in the country where the men on whom rests the responsibility as to the adoption of new devices permit the wool to be pulled over their eyes out of combined ignorance and good nature, and are wheedled into doing and saying things of which they are not sure at the time, and which they afterward regret when too late to recall.

More independent thought and investigation is needed in railway mechanical departments. The men at the head of the Pennsylvania railroad are wise in providing a staff for their mechanical officers large enough to permit time to be given to this important work.

[TO BE CONTINUED.]

## CORRESPONDENCE.

### The Louisville Tornado—A First Class Trestle.

NEW YORK, N. Y., April 21, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: There has been, I believe, no accurate technical account yet published of the recent cyclone at Louisville, Ky. Before the traces of its force and path are obliterated it is to be hoped that some one will put on record a scientifically accurate description.

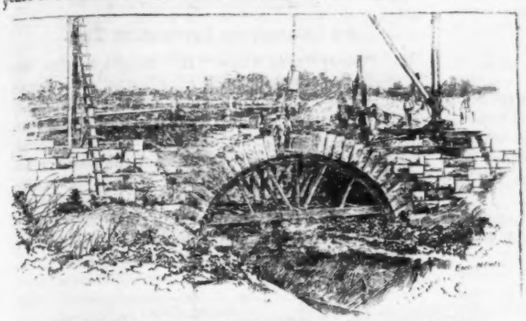
A few hours spent last week in Louisville, while unfortunately not sufficient to permit of a careful examination of the scene, nevertheless allowed me to note some of the striking features of the storm. In the first place, while the general path of the storm is fairly clearly marked, its force in the area passed over was far from constant. Thus, frequently several buildings would be left standing together like an island, where all the surrounding building, would be totally demolished. In other places buildings on one side of the street would be destroyed, while those opposite, directly in the line of storm, would be uninjured, not even a sign removed. In other places the wind apparently came downward, struck the earth, and then was deflected upward, the line of the vertical curve being traced by the destruction wrought. Thus, where the wind first struck, the houses lost their roofs; those next in line lost the roofs and upper stories, and then the whole house would be down; those next following would have the lower floors intact. Then would come houses again with only the roofs off, thus showing how the wind came down and went up.

The most remarkable exhibition of this downward force is exhibited in the case of the Chesapeake & Ohio Ry. station, a fine modern building with an arched roof covering several tracks. This building stood under a small bluff and was completely demolished, while some old buildings standing on the high ground to the windward side of the station were wholly uninjured.

The power exerted by the wind must have been very great. At any one point the area affected by the wind was small, but the complete havoc of stout brick walls attests the great force present. The cyclone came very suddenly and comparatively noiselessly.

At the time there was a general wind and rain storm raging, but the people occupying houses located in the same squares as those destroyed were totally unconscious that anything had occurred.

While speaking of dangerous things, I must mention a sample of bridge practice that recently came to my attention. On a railway in a prosperous section of a very prosperous State there are some wooden trestles. They had been built originally for narrow gauge, and when the track was widened the stringers were not moved. The rails, which were only 35 lbs. per yard in weight, and consequently relieved the stringers of no appreciable strain, overhung the side of the stringers 7 ins. The ties, which thus acted as cantilevers, were 6 × 8 ins., and spaced about 20 ins. between centres. There was no guard rail. The stringers were solid and only 10 × 12 ins. in section, 8 years old, bents 12 ft. apart, and carrying a 32-ton engine.



**Harlem Arch; Centers in Place, June 15, 1889.**

This produces an extreme fibre strain of about 2,000 lbs. The foundations (begging the word's pardon for its misuse) had been of mudsills, but they had settled and the trackmen from time to time cobbled them up with boards to restore a bearing. The collection of boards and shingles in some places would have been laughable, had it not been such a serious matter. This is the worst case of dangerous trestle in my experience, and it is to be hoped cannot be equaled; but unfortunately there are many other structures in different parts of the country nearly as bad, maintained through criminal ignorance. If an example were made of those responsible when one of these death traps collapses, there would soon be an improvement. In the case in point the receiver is aware of the bad condition and is devoting all his spare revenue to the repairs of these trestles.

WM. BARCLAY PARSONS.

## Rules for Vertical Curves.

DENVER, Colo., April 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the question, "Rules for Vertical Curves."

In my practice I have found it necessary to have complete notes in book form showing the elevations at regular station distances, as measured along the constructed line, and not from any point of intersection of grades—*i. e.* the P. C. of a vertical curve—falls at, say, station 210 × 05; what would be the elevation at station 210 × 50? The idea being to put in 50-ft. station on said curve.

I quote from some recent instructions I have been engaged upon

"When the rate of ascent or descent changes, the gradient lines must be connected with a vertical curve, calculated by the following formula:

$d = D\frac{N^2}{T^2}$ distance from apex to curve, being one-half (½) of the algebraic difference (grade angle) of rate of grades from apex. $d$ = distances from points on tangents to points on vertical curve. $N$ = distances from P C on tangent. $T$ = tangent or distance from P C of curve to apex.

The engineers must exercise good judgment in determining the length of the vertical curve to be used in each case.

When the grade angle does not exceed 2 ft., a length of 400 ft. for the vertical curve will generally be sufficient.

In case the grades exceed 2 ft. introduce grades that will make that amount.

Yours truly,

R. C. SIMONS.

## Deflection Tests of the Peoria Bridge.

PEORIA, Ill., April 9, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: While not wishing to continue at great length the discussion with reference to the bridge question at Peoria I desire to say with reference to the deflection tests made by me that it seemed to be the most available plan to immediately determine whether the bridge should be condemned at once, or whether the company should be allowed to run trains over it, and whether they should be required before doing so to rebuild the bridge. You will see that nowhere in my letter is there a statement that on the basis of these tests the Board permitted or did not permit the running of trains, nor approve or condemn the bridge. It was only so much evidence furnished to the commissioners, and to the public through ENGINEERING NEWS. It was given to the public through no other source. The report of Mr. HANSEL to the State Board of Railroad and Warehouse Commissioners has not been published and will not be; but it is generally thought here in Peoria that the Peoria & Pekin Union Railroad Co. is making preparations to rebuild the bridge or replace it by an entirely new structure of steel.

I would like to ask if you could suggest any better method for a hasty determination whether a railroad bridge is to be used or immediately abandoned, than by running heavy trains over it and observing the deflection and recovery.

R. R. BOURLAND.

[There certainly is a better method, to have the bridge at once examined by a competent bridge engineer. If a bridge, under an unusually heavy yet not excessive load fails to recover completely, it is certainly a good evidence that it is in a dangerous condition, and in that sense the test is useful; but if the bridge does recover, it is not the slightest evidence that it is fit for service. It may easily be in a most dangerous condition and yet show neither permanent set nor excessive deflection.—ED. ENG. NEWS.]

## Compound Locomotives in Russia.

BORISOGLEBSK, Tamboff Gov., RUSSIA, April 3, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I had much pleasure in receiving your issue of March 8 containing, among other interesting matter, special data on the compound locomotive. I am pleased to notice that even in the United States this system is now growing gradually into favor. I have not the least doubt the time is not far distant when no other type will be built for main line service—I mean all train service, whether on main or branch lines, to the exclusion of shunting service.

I forward per parcel post a complete set of drawings, showing our compounded passenger locomotives on the Grazi-Tsoritsin Railway. I will not dwell on the particulars of this transformation, as you will best understand it from the copy of my paper on the results of compounding existing locomotives burning petroleum refuse in Russia.

The goods compounds, six wheeled, coupled, are done on the same lines, the only difference being the dimensions of cylinders and no intercepting or interchanging valves are used on goods compounds; that is, they can work only on the compound system, whereas the passenger locomotives can work compound or non-compound.

From a year's working with about 15 locomotives, three of which are passenger locomotives, the mean economy comes out at 18 per cent. saving in liquid fuel as compared with non-compounds also burning liquid fuel. From the results of the last three months of last year and first two of this year, I have every hope that the mean result will be for 1890 an economy of 20 per cent. More than this I cannot expect while retaining the original working pressure of nine atmospheres in our old boilers. A very complete account of my experience you will notice in *Engineering* of Feb. 21 and March 7. I shall be delighted to see a notice of this most successful example of compounding in your valuable paper.

THOS. URQUHART,
M. Inst. C. E., M. Inst. M. E.

[An abstract of Mr. URQUHART's paper was given in our issue of March 15. While petroleum fuel has been successfully used in this country for locomotives, it will not come into any extended use, for the consumption on the Pennsylvania Railroad alone would be nearly half the total oil production of the United States, as we have before noted. The compound locomotive, however, appears likely to be very generally adopted, and we shall endeavor to keep our readers fully informed on its progress.—ED. ENG. NEWS.]

## Stadia Practice.

ROME, N. Y., Feb. 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I think the stadia device referred to by Mr. FORD in your issue of Feb. 8, page 136, would be very cumbersome and of minor utility. A good plan, I think, is for the rodman to have or improvise a small square or right-angled sight, which he holds against the rod at a constant height equal to the H. I. For the distance sight the rodman inclines the rod until one side of his square points to the telescope, and sets the foot of the rod back or forward, according as the telescope is elevated or depressed, until the square is directly over the stake or point whose position is required. To those familiar with stadia work it will be evident that the rodman will need no plumb bob for the purpose. For the elevation sight the rod must, of course, be held vertically over the stake, and sight taken on the constant point, or H. I. on the rod. In any case, tables of reduction are required to obtain from the hypothenuse and angle of elevation or depression the opposite and adjacent sides, *i. e.*, the elevation and horizontal distance.

J. W. LEDOUX.

## Arches and Arch Centres.

OFFICE OF WATER COMMISSIONERS, ST. LOUIS, March 10, 1890.

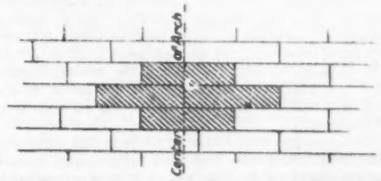
TO THE EDITOR OF ENGINEERING NEWS:

SIR: The culvert shown on illustration given is for the purpose of carrying the Harlem Creek under the water works conduit now under contract. The creek drains about 5,000 acres.

The print showing centres in was taken on Saturday afternoon June 15, 1889. As the weather was threatening, orders were given to push work, and key up arch before leaving. Arch was keyed about 7.30 P. M. when rain began.

At 11 P. M., the washout occurred without doing any damage.

Second print taken Monday A. M. The post and jack under arch were put in to form support for four of the centre stones which could not be set in place on Saturday. The stones in place were thus:




**Harlem Arch; the part cross-hatched shows arch stones missing at the time of washout.**

A small hole was put in the centre of the arch. The four stones, cross-hatched, were put in place after the washout occurred. Span of arch was 30 ft.; total settlement at crown, ¼ in.; shape of arch, elliptic. Construction proceeded as though nothing had occurred.

The matter was of some interest to us, as there had been considerable discussion as to the length of time the centre should remain after arch was keyed.

The prints are forwarded as an example of a washout which was harmless, but may do some good as a caution to the younger members of the profession; that is, to have arch stones *all cut* before setting is commenced.

Yours truly, M. L. HOLMAN.

**Harlem Arch; Centers Washed Out, 11 p. m., June 15, 1889.**

## English and American Railway Practice in Mexico.

OAXACA, Mexico, April 8, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Please allow me a few words under the above head in reply to Mr. Braine, of Jalapa, Mex., in your issue of March 22.

He denies the statements of my letter of Nov. 16. I stand corrected; accept his contradiction, and plead guilty of writing from other than personal knowledge of the

English practice. It was only common gossip among railroad men in Mexico and Puebla. However, if I mistake not, Mr. Braine's letter almost convicts its author of a portion of the charges.

I made no complaint of the practice of ploughing a furrow along the center line after location; it was the absence of other guide for the contractor for long distances. In this connection Mr. Braine says: "Personally, I have known of no case where work has been opened without stakes, unless from failure on the part of the engineer in charge." If failures were frequent they *might* constitute a practice.

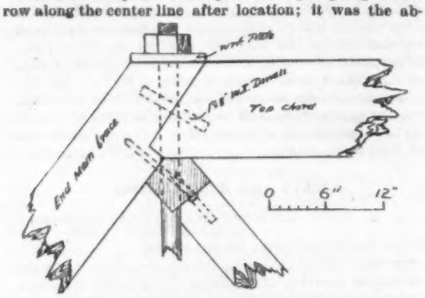



Fig. 1.—Top Chord End Joints for Howe Truss Spans up to 90 ft.

He seems to have entirely gone back on his country's custom in regard to even radii. He boldly assures us that his road with an English chief is following the American practice by laying out curves by even deflection and odd radii. He even gives us 190 kilometers of examples. Yet immediately following this, in quoting the specifications of his road, he mentions four different curves all of even radii. If he had gone a little deeper into the history of that 190 kilometers, we might have learned that much the larger part, if not all of it, was located by a contracting firm, employing an American chief engineer.

Mr. Braine refers with apparent pride to the custom of building substantial stone and iron bridges, and spreading ballast ahead of tracklaying. A first-class roadbed is something to be proud of, and to be commended. Finishing ahead of tracklaying may possibly be economical in conservative Mexico, but the Yankee has not yet discovered it.

The American looks with appreciation upon the fine substantial road of his English rival, while he is more than amused at the contrast between a first-class track and the antediluvian rolling stock that rides it.

F. MEREDITH JONES.

## Notes and Queries.

W. T. S. writes: Please inform me if you have any books on foundations for structures in general, also on the freezing process, and if any such articles have appeared in your journal please let me know the numbers of the papers. Baker's "Masonry Construction" has a good deal on foundations that is new and valuable. For the freezing process consult Sooysmith & Co., No. 2 Nassau St., and back files of this journal. We cannot undertake to look up references to particular matter in back volumnes. Our files are open for any one to search in.

## Howe Truss Bridges, Oregon Pacific R. R.

[WITH INSET.]

We present on the large inset sheet accompanying this issue the standard designs of the Oregon Pacific R. R., sent to us by the kindness of Mr. ARCHIBALD A. SCHENCK, Chief Engineer, which we believe to be

Fig. 2.—Cast Brace-Block for Howe Truss Spans under 100 ft.

safe and careful designs, in accordance with the latest and best practice in wooden bridge construction, which for a long time to come will be an important department of American engineering work, although one of continually decreasing relative importance.

One fact we should especially call attention to, that these bridges are designed for a region where very long timber is readily obtained, and is no more expensive than short timbers, so that the sections given for lower chord would be much weaker in proportion to regions where equally long timber was not available. The great difference in the amount of iron required when the rods are upset or not upset is curiously shown in the table in the corner of the sheet of diagrams.

The spans included in the diagrams are:

30 ft. half-through and deck.
40 " " " "
50 " " " "
60 " " " "
70 " " " "
80 " " " "
90 " through, half-through and deck.
100 " " and deck,
110 " "
121 " "
130 " "
140 " "
150 " "

This includes in all 27 different trusses, covering the entire range usually required for wooden trusses spans exceeding 150 ft. being rarely built of wood.

In a letter transmitting these strain sheets, Mr. W. A. DOANE, M. Am. Soc. C. E., gives the following further details:

"Howe truss bridges, not yet having had their day—at least in the South and West—I send you a set of strain sheets from 30 ft. to 150 ft. spans, designed for heavy traffic. They require little explanation beyond that given by the attached notes and table of data.

It is intended to use upset rods for all spans above 60 or 70 ft., although diameters given are those required to give the necessary area at root of thread. The table of data gives approximate weights in each case. As will be seen, from 1,000 to 9,000 lbs. of iron per span are saved by upsetting the ends of rods.

It is believed that some details of construction have been improved in these designs.

"Fig. 1 (enlarged scale) shows the general style of joints at junction of top chord with end mains for all through spans up to 90 ft.

"Fig. 3 shows general style of portal bracing, etc. for through spans over 90 ft., these having a system of top lateral bracing. In no case are vertical end posts used to meet a useless prolongation of top chord in through spans.

"For spans of 100 ft. and over, the usual style of cast brace blocks is followed, having tubes slightly let in to chord timbers and long enough to reach the opposite face of chord and receive the strain transmitted from the rods through the plates. These latter are in all cases made unusually wide, however.

"In spans less than 100 ft., the tubes are dispensed with, and a block of the style shown in Fig. 2 is used, having a full bearing on the chord as well as for the braces, while the radial longitudinal ribs greatly increase the strength. The open ends are not objectionable."

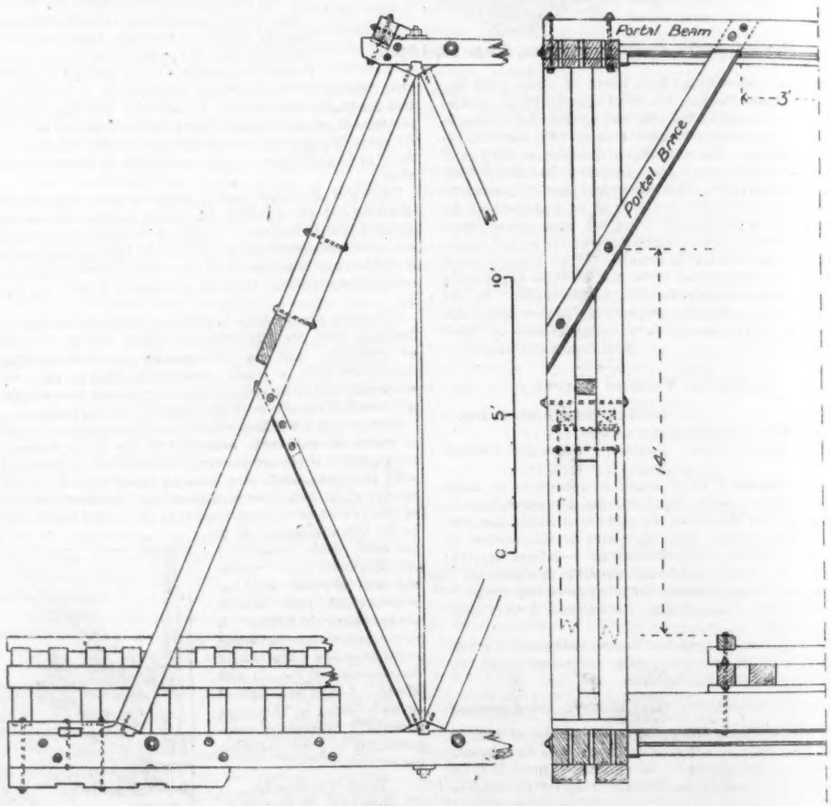



Fig. 3.—Portal Bracing for Howe Truss Through Spans of 90 ft. and over.

## An Interesting Locomotive Test.

A Pennsylvania Class "R" freight engine, the largest type of engine built at Altoona, on a recent trial on the Pittsburg, Fort Wayne & Chicago R. R., hauled 79 cars loaded with iron ore and 6 with pig metal, making a total of 85 cars, weighing, loaded, 2,400 tons. For a portion of the distance the grade was 15 ft. per mile. On this grade the engine worked full stroke, the throttle being wide open. A speed of only 6 miles an hour was attained, but the test proved that this engine has sufficient adhesive power to utilize the full power of the cylinders on a good rail without slipping, and also that on a grade of 15 ft. per mile it would not stall with this immense load behind it. The weight of this locomotive on the drivers is 100,600 lbs., on truck, 14,025 lbs., or 114,625 lbs. in all, to which add 56,800 lbs. for the loaded tender, giving 171,425 lbs. in all, or 85.71 tons. As the tender may have been only partly loaded, we may call this 80 tons, making the total weight of the train 2,480 tons.

At 6 lbs. per ton *plus* 5.6 lbs. for the resistance of a 15-ft. grade, the total resistance of this train would be $2,480 \times 11.6 = 28,768$ tons, and $\frac{171425}{28768}$ gives a ratio of adhesion of about $\frac{1}{6}$, thus corrresponding closely with innumerable other experiments in which the tractive power of American locomotives has been found to be between $\frac{1}{5}$ and $\frac{1}{4}$.

But few tests of a similar kind have been made abroad on European locomotives, our foreign friends not seeming to think it of much importance to increase the loads hauled by locomotives, and certainly not doing so in practice to any considerable extent. We know of no instance in which more

than ½ the weight on drivers of a European locomotive has been realized for tractive power, and do not believe that any engine without equalizing levers can utilize more than this, even in a test.

THE GERMAN FIREPROOF FLOOR, referred to in our issue of April 12, has very recently been introduced into this country, and is represented here by the Eastern Plaster Board Co., of 52 Broad St., New York. Works are being built at Bergen Point in New Jersey, and the parent company, the American Plaster Board Co., of San Francisco, is now filling a large contract for the city of Rio Janeiro, S. A. The boards made are usually 8 ft. long and 10 ins. wide and from ½ in. to 6 ins. and more thick. They are made from a plastic mass of cow-hair, cork clippings and plaster poured over a layer of reeds. They are light, easily transported, can be readily sawed or nailed, are cheap, and are especially valuable as avoiding delay in waiting for ordinary walls or ceilings to dry. They are highly recommended from a sanitary point of view.

## RAILWAYS.

### EAST OF CHICAGO—Existing Roads.

***Rochester, Gilman & St. Louis.***—A press dispatch from Winamac, Ind., says:

At a meeting of the directors and stockholders of this company, recently held, the following directors were elected: J. K. Lee, A. D. Toner, H. E. Patterson, J. B. Agnew, F. L. Wagner, J. S. Slick, W. C. Bennett, S. P. Thompson, A. J. Delong, W. H. Allen and B. Noland. J. K. Lee was elected President, A. D. Toner, Vice-President, William H. Bouslog, Treasurer, and John T. Holsinger, Secretary. The bonds were placed and the contract awarded to C. A. Benjamin, of New York City, who will commence construction at once.

***Kinderhook & Hudson.***—A press report states that tracklaying on this road will be completed in a few days. The road runs from Kinderhook to Hudson, N. Y., 16¼ miles. E. G. Ferris, of Hudson, N. Y., is Chief Engineer.

***Columbus, Lima & Milwaukee.***—Tracklaying will commence on the 40-mile division between Lima and Defiance, O., as soon as the ground will permit. The contract for the line from Lima to Columbus will be let soon. B. C. Faurot, of Lima, O., is President.

***Wheeling & Lake Erie.***—The survey for the line from Portland Station to Bellaire, O., has been completed.

***South Pennsylvania.***—This company has been reorganized with Geo. F. Baer, of Reading, Pa., as President. The company was chartered some time ago to build a railway from Harrisburg to Pittsburg, Pa., and a considerable amount of work, grading and bridging, was done at the time. It is reported that the work will be resumed and the road completed.

***Northwestern Monroe.***—H. A. Blair, of Mansfield, O., writes us as follows concerning this enterprise:

This road is now completed and in operation from Lucas, O., northwest to the stone quarries, a distance of about 3 miles. The road is built in the interest of the stone industry at Lucas, O. It is the intention of the company to extend its line as the business demands. The road does a freight traffic only. Chas. W. French is General Manager.

***East Broad Top.***—Surveys are being made for an extension from Robertsdale to a new shaft, a distance of 6,000 ft. or 7,000 ft.

***Shade Gap.***—Grading has been commenced on the 3-mile extension of this road from Goshorn to Richvale, Pa.

***Baltimore & Ohio.***—This company has submitted to the citizens of Cumberland, Md., a proposition to make that point the terminus of the second and third and Pittsburgh divisions of the road, and to concentrate the machinery employés now engaged in repairing its locomotives in Martinsburg, Keyser, Piedmont, and Connellsville, effecting a change of 2,000 men. In consideration of this they ask the city to loan them $150,000, which is to be repaid by the company at the rate of $10,000 per annum without interest, the first payment to be made two years after the date of the city bonds issued for the loan. The company will expend the $150,000 received in the erection of roundhouse, machine shops, etc., and will secure the city the repayment of the amount by a first lien on the property and their improvements, the contract to remain in force until the entire sum of money is repaid to the city of Cumberland.

***American Midland.***—J. P. Carrothers, Receiver, is quoted as saying that a sufficient amount of this company's stock had been purchased by New York and Chicago parties to give them control of the road. He also stated that at the receiver's sale, which will be held in June, they would gain entire possession of the road and would finish it as originally projected to Fort Wayne, Ind.

***Philadelphia & Reading.***—A press dispatch from Philadelphia says:

During the next few months this company will make extensive improvements at its Port Richmond terminal. Six miles additional siding room for cars will be laid, and a new shipping pier will be built that will have a capacity for loading 40,000 tons of coal a day into barges and vessels. In addition to this, a coaling station for locomotives is being erected, which will be equipped with link belt machinery so arranged that coal can be loaded into the tanks of the engines and ashes taken out from the ashpit at the same time. Another float ship will be constructed to accommodate the freight traffic between Port Richmond and the Reading's new Delaware Ave. station. Additional platforms and storage warehouses are to be erected, and it is the intention of the Reading Co. to make Port Richmond the most complete terminal station in Philadelphia.

***Pennsylvania.***—This company is stated to be considering an extension of the Belvidere & Delaware R. R. to a connection with the New York, Susquehanna & Western R. R. The line will be about 4 miles long, and is projected to give this company a line to the Poughkeepsie Bridge.

### Projects and Surveys.

***Cleveland Belt Line.***—Incorporated in Ohio to build a line of railway from a point on the Cleveland & Canton R. R. between Newburg and Broadway stations, in the city of Cleveland, to a point on the New York, Chicago & St. Louis R. R. near Wilson Ave. Among the incorporators are: J. W. Wardwell, A. S. Emery, H. A. Kennedy and Charles H. Blood.

***Providence & Norwich.***—The Rhode Island Legislature has passed a bill incorporating this company, with power to build a line of railway from Providence, R. I., to Volunton, Conn., and thence to Attleboro, Mass. The object of the road is to give a short connection between Boston, Providence, and the West.

***Phillips & Rangeley.***—At a meeting of the directors recently held the following officers were elected: President, H. P. Clossen; Secretary, F. E. Timberlake, and General Manager, Wm. A. Rich. The officers will hold a meeting soon to award the contracts for building the line. The road is projected to run from Phillips to Rangely, Me., a distance of 27 miles.

***Nipissing & James Bay.***—This company has been reorganized, and it is now expected that active steps will be taken to commence construction at once. The road is projected to run from Lake Nipissing to James Bay, a distance of about 350 miles. Chief Engineer, J. C. Bailey, 211 Carlton St., Toronto, Ont.

***Dutchess County.***—Chartered in New York to build a line of railway from Poughkeepsie to a connection with the New York & New England R. R., at Hopewell Junction. The directors are: J. C. Stanton, D. J. McNiece, Thos. F. Mason, Wm. B. McNiece, and D. Odell, of New York City, and D. N. Stanton, of Yonkers, and W. R. Todd, of Morristown.

***Grand Rapids, Chicago & St. Louis.***—Charles E. Temple, of Grand Rapids, Mich., Vice-President and General Counsel, has given us the following information concerning this enterprise:

The road is to run from Grand Rapids, Mich., via Jonestown, Holland, Douglass, Glenn, Hawkshead, South Haven, and Coloma, to Benton Harbor, a distance of 80 miles. The line between Grand Rapids and Holland has been located and the survey for the line between Holland and Benton Harbor will be completed in about 3 weeks. The work will be generally easy; maximum grade, 40 ft. per mile. The route is through a level farming country, and it is expected that the road will have a large business in coal, stone, timber, and fruit and other farm products. The right of way has been obtained, and about $50,000 of other local aid secured. The Grand Rapids & Indiana R. R. will operate the road when completed. The company was chartered March 27, 1890. W. D. Tolford is President, and Wm. McLoughlin is Chief Engineer.

***Plymouth & Middleboro.***—The committee appointed to consider the question of the town of Plymouth, Mass. voting $40,000 in aid of this road, has made its report. The committee does not recommend the appropriation.

### SOUTHERN.—Existing Roads.

***Southern & Western Air Line.***—Engineers will soon commence the location of this line from Shelby to Linville, N. C. Twenty-three miles of the line are already graded, and the preliminary survey has been completed on the remainder. Col. S. McD. Tate is President and W. E. Walton is Chief Engineer, both of Morganton, N. C.

***Millen & Southern.***—J. W. Preston, of Rogers, Ga., General Manager, sends us the following concerning this enterprise:

This is a reorganization of the old Rogers & Stilmore R. R. It is proposed to take up 9 miles of the old track from Rogers south and to deflect the north end of the road to Millen, Ga. The road will then be extended from Stilmore to Stirling, Ga., a distance of 48¾ miles. Nearly all of the right of way has been obtained. There will be a 6,200 ft. bridge across the Ogeechee River and swamp. The contract for this bridge has been let to C. K. Leutner and the contract for the grading to J. M. Willis. L. R. Millen, of 16 Beaver St., New York City, is President.

***Columbus Southern.***—The Chattahoochee Brick Co. has turned this recently completed road over to the directors, and the road will hereafter be operated by the company.

***Richmond & Danville.***—The rails have all been secured for the completion of the Western North Carolina R. R., and tracklaying will begin May 1. The line is now completed to a point five miles from Murphy, N. C.

***Savannah, Americus & Montgomery.***—Surveys are now in progress for an extension from the Chattahoochee River to Montgomery, Ala. A report is in circulation that this company has under consideration an extension from Sterling to Darien, Ga.

***South Bound.***—The South Bound Construction Company has been organized to build this road from Savannah, Ga. to Columbia, S. C.

***Charleston, Sumter & Northern.***—Preparations are being made for the early extension of this road from Sumter to Bennettsville, S. C. Surveys are now in progress, and the line will be ready for the contractors in a short time. A large part of the right of way has been secured, and no difficulty will be had in obtaining the remainder.

***Seaboard Air Line.***—The engineers of the Georgia, Carolina & Northern R. R. are now locating the line between Jug Tavern and Atlanta, Ga.. The location has been completed from the Savannah River to Jug Tavern, and the line is under contract from the Savannah River to Athens, Ga. Two lines are under consideration between Jug Tavern and Atlanta.

***Norfolk & Western.***—The tracklaying on the Clinch Valley Division of this road has been completed to Kiser Tunnel, 69 miles west of Graham Junction and 5 miles east of Bickley's Mills, which place was not reached on April 10, as was expected. It is now expected that Bickley's Mills will be reached by May 1. The line is now in operation to Honaker, and train service will probably soon be extended to Cleveland, Va. The Little Tom Tunnel, on Geo. T. Neill's contract, has been holed, and work is being pushed vigorously between St. Paul and Norton, Va. It is hoped to have the line completed to Norton by Sept. 1.—About 14 miles of the Cripple Creek extension to the North Carolina State line have been completed, and tracklaying will commence shortly. It is proposed to have the entire extension of 40 miles completed within one year.

***Louisville & Nashville.***—About two-thirds of the grading has been completed on the Cumberland Valley extension, which is to run from Cumberland Gap, Tenn. to Big River Gap, Va., 70 miles. Tracklaying will begin soon. The line passes through the Cumberland Gap tunnel and connects with the Pineville Branch of the L. & N. R. R. At the eastern end the road connects with the Clinch Valley Division of the Norfolk & Western R. R. now under construction. R. E. O'Brien is the Engineer in charge.

***Cape Fear & Yadkin Valley.***—About 430 men are now at work on the extension to the Virginia State line. The length of the extension will be about 8½ miles, and of this distance 3 miles have already been graded. The grading on the branch from Mt. Airy to the quarries of the Mt. Airy Granite Co., 2 miles, has been completed and the bridging is now being rapidly constructed. The line will probably be completed next month.

### Projects and Surveys.

***Atlantic, Atlanta & Great Western.***—We have received the following information from Geo. T. Fry, of Chattanooga, Tenn., concerning this enterprise:

The surveys are all completed for the road, which is projected to run from Atlanta, via Eatontown, Sparta, Waynesboro, and Springfield, to Savannah, Ga., a distance of 270 miles. The route is generally very favorable; maximum grade 66 ft. per mile, and maximum curve 6°. The road passes through a fine mineral and agricultural section of the State and it is expected that a large traffic in timber, granite, cotton, and general merchandise will be obtained. About 200 miles of the right of way have been obtained and nearly $5,000,000 of other local aid secured. The remainder of the money necessary to build the line will be secured by the sale of bonds. It is expected to let the contracts and commence construction during the present season. W. T. B. Wilson, of Chattanooga, Tenn., is Chief Engineer.

***Murfreesboro.***—B. B. Winborne, of Murfreesboro, N. C., sends us the following:

This company proposes to build during the summer or fall of 1890, a line of railway from Conway, N. C., to Murfreesboro, N. C., a distance of 7 miles. The road will pass through a favorable country, and it is expected will have a large traffic in lumber and farm produce. About $25,000 local aid has been secured, and the company desires to correspond with capitalists who will construct the line, taking in payment therefor the bonds and mortgages of the company.

***Anniston & Montgomery.***—C. C. Wrenshall, of Anniston, Ala., Chief Engineer, writes us that the surveys have been completed for this road, which is projected to run from Anniston to Montgomery, Ala., a distance of 110 miles. About 75 miles of the line is through a rough country; maximum grade 66 ft. per mile, and maximum curve 8°. All of the right of way has been secured. John W. Noble, of Anniston, Ala., is President.

***Athens & Jefferson.***—R. L. Moss, of Athens, Ga., has sent us the following concerning this road:

It is projected to run from Athens to Jefferson, Ga., a distance of 18 miles. The route is very favorable and the road easy of construction. There are no towns along the route and the only business will be the freight and passenger traffic between the terminal points. The enterprise is some years old and is now practically abandoned.

***Atlanta & Alabama.***—We have received the following information from L. E. O'Keefe, of Atlanta, Ga., Secretary:

The survey has been partly made for this road, which is projected to run from Atlanta to Selma, Ala., 175 miles. The road will run through a section of the country rich in timber and minerals, and containing a large amount of fine agricultural land. The principal business of the road will be in cotton, coal, and iron. Henry B. Tompkins is President.

***Cranberry & Linville.***—J. R. Irwin, of Linville, N. C., Chief Engineer, writes as follows concerning this project:

The preliminary surveys have been completed for this road, which is to run from Linville to the Cranberry iron mines, a distance of 13 miles. With the exception of 4 miles the line is very favorable; maximum grade, 132 ft. per mile, and maximum curve 14°. Hugh McRae, of Linville, N. C., is President.

***Franklin & Nasheville Dummy.***—The preliminary survey for this line has been completed and a very favorable route is stated to have been secured. The road is to be run from Franklin, Tenn., to Glendale Park, a distance

of 13 miles, where connection will be made with the line to Nashville.

*Washington & Lincolnton.*—A construction company has been organized to build this line from Washington to Lincolnton, Ga., 20 miles.

*Tuscumbia & Riverton.*—Work, it is stated, will begin at once on the main line from Tuscumbia to Riverton, Ala.

*Bridgeport Southern.*—Incorporated in Alabama to build a line of railway from Bridgeport to Guntersville, Ala. Among the incorporators are: J. T. Douglass, Fort Payne, Ala.; R. C. Johnson, Bridgeport, Ala.; J. E. Brown, of Scottsboro, Ala., and A. J. McBride, of Atlanta, Ga.

*Missouri, Tennessee & Georgia.*—The location of the first 20-mile section of the division between Humboldt, Tenn., and Hickman, Ky., has been completed, and work on construction will begin soon. E. P. Buell & Co., of Tarlton, O., are the contractors.

*Monticello & Tampa Air Line.*—Surveys will commence at once on this Florida line.

*Danielsville.*—A charter will be applied for for the construction of a railway from Danielsville, Ga., to a connection with the Georgia, Carolina & Northern R.R., a distance of 8 miles. The road will be graded by the people along the route, and the rails and equipment purchased by local subscription.

*Concord & Mt. Pleasant.*—The survey has been completed for this road, which is projected to run from Concord to Mt. Pleasant, N. C. It is stated that work will be commenced at once.

*Thomasville, Silver Valley & Pee Dee.*—A meeting of the stockholders will soon be held to complete the organization of this company, which was chartered at the last session of the North Carolina State Legislature.

*Talbotton & Western.*—Surveys are now in progress between Talbotton, Ga., and the Flint River, via Prattsburg and Carsonville. As soon as this line is surveyed the engineers will begin the survey of a line from Talbotton to a point on the Georgia Midland & Gulf R. R. between Waverley Hall & Ellerslie. It is stated that construction will commence as soon as the surveys are completed.

*St. Albans & Coal River.*—It is stated that all the arrangements have been completed for the construction of this West Virginia road. It is expected to complete the line to Boone C. H. this season.

*Tavares & Punta Gorda.*—A company has been organized to build a line of railway from Tavares to Punta Gorda, Fla. Among the incorporators are: D. G. Ambler, H. J. Jackson, and Charles Tremain.

### NORTHWEST—Existing Roads.

*Chicago, Rock Island & Pacific.*—A press dispatch from Omaha, Neb., says:

A contract has been signed by Presidents Cable and Miller of the Chicago, Rock Island & Pacific and the Chicago, Milwaukee & St. Paul railways by which those two roads will run solid trains into Omaha within the next 30 days. A contract between the Rock Island and St. Paul people and General Manager Holcomb, of the Union Pacific, provides for trackage and other privileges in connection with the Union depot now in process of construction, and joint use by the Rock Island of the Union Pacific track to Gilmore Station, nine miles south of Omaha. The Rock Island proposes to build from Gilmore to Lincoln, from which point it will use the Union Pacific tracks to Beatrice, thus connecting the Rock Island's main line with the Denver system. The Gilmore-Lincoln extension will be used jointly by the two roads. The deal, which has been under consideration for several days, now only awaits the signatures of the directors of the roads concerned.

### Projects and Surveys.

*Lincoln & Western.*—A construction company has been organized to construct this road from Lincoln to Prosser, Neb. The contract price is $100,000.

*Midland Pacific.*—A bill has been introduced into Congress granting this company the right of way for its road across the Crow Creek Indian Reservation in South Dakota.

*Chicago & Eastern.*—Chartered in Illinois to build a line of railway from Chicago to a point on the Indiana State line in Cook County.

### SOUTHWEST—Existing Roads.

*Missouri Pacific.*—Work on the Fort Scott & Eastern and the Fort Scott Belt Line railways is making rapid progress. Tracklaying is now completed on the former from Fort Scott, Kan., to Richmond, Nev., 13 miles, and will soon be completed to Rich Hill, Mo. Surveyors are now at work on the belt line and on the extension to Minden, Mo.

*Hutchinson & Southern.*—Tracklaying is stated to have been commenced on the extension of this road south to the Indian Territory line. It is expected that this portion of the road will be completed by June 1.

*Gulf, Colorado & Santa Fé.*—It is stated that this company will soon commence the survey for a line from Alvin to Velasco, Tex.

*Weatherford, Mineral Wells & Northwestern.*—Work, it is stated, will soon commence on the extension of this line from Weatherford to Mineral Wells, Tex., 18 miles.

*Fort Worth & Albuquerque.*—Grading is progressing on this Texas road. The contractors are now pushing work and the grading will soon be completed between Ft. Worth and Springtown. As soon as this portion of the line is graded tracklaying will commence.

*San Antonio & Aransas Pass.*—Work on the Waco branch is making rapid progress. The bridging and a large part of the grading has been completed and tracklaying will be completed in 30 days.—About 50 miles of the branch from Houston, Tex., to Alexandria, La., are now under construction.—Surveys, it is stated, will soon begin on the line from Waco to Paris, Tex.

### Projects and Surveys.

*Corsicana & Southeastern.*—Chas H. Allyn, of Corsicana, Tex., President, sends us the following information concerning this enterprise:

This road is projected to run from Corsicana, Tex., via Fairfield, to a connection with the International & Great Northern Ry., at a point near Kiechi, a distance of about 50 miles. Surveys were commenced on April 20. The object of the road is to give Corsicana an outlet to an independent system. The principal business will be the local traffic of Freestone Co. No right of way has been obtained. About $200,000 of stock has been subscribed in aid of the enterprise. W. T. Walker is Chief Engineer.

*Tennessee, Arkansas & Texas.*—Organized in Arkansas to build a line of railway from Little Rock, via Hot Springs, to some point on the Indian Territory line.

*Fremont, Elkhorn & Missouri Valley.*—This company is surveying a line from Buffalo Gap to Hot Springs, Ark.

### ROCKY MT. AND PACIFIC.—Existing Roads.

*Northern Pacific.*—Henry Villard is quoted as saying that within the next four years this company will expend fifty or sixty millions of dollars in constructing extensions in the northwest, and particularly in Montana and Washington.

*Union Pacific.*—It is expected to have the Cheyenne & Northern R. R. extension completed by July 15.—This company is reported to have secured control of the Tacoma & Lake City R. R., and will, it is stated, extend it to Olympia, Wash.

*Northern Pacific.*—This company proposes to construct a line from Davenport, Wash., down the Skagit River to Anacortis, Wash. Construction is now in progress upon the extension from Tacoma to Gray's Harbor, mentioned in our last issue.

*Santa Fé Southern.*—The necessary $3,000 required to procure the right of way for the proposed extension to San Pedro, N. M., has been raised by the people of Santa Fé. The construction of the road will, it is expected, begin at once.

*Great Falls & Canada.*—At a meeting of the stockholders, recently held, the following officers were elected: President, Donald Grant; Secretary, W. A. Barr, and Treasurer, Sam Grant. About 500 men are now at work on the grading on the southern end of the line.

*San Pete Valley.*—This narrow gauge road running from Nephi to Manti, Utah, 27 miles, has been purchased by the Union Pacific Ry. Co., which proposes to change it to standard gauge and extend it south from Manti.

*Ellensburg & Northeastern.*—The $4,500,000 of first mortgage bonds of this company have been placed. Work will, it is stated, be commenced at once and the road completed as soon as possible. Already about 10 miles of the line from Ellensburg to the Columbia River have been graded, and the surveys have been completed to the Coal mines. John A. Shoudy, of Ellensburg, Wash., is President.

*Port Townsend Southern.*—Work is rapidly progressing on the first 20 miles of this road, which is to be completed by July 1. Surveys are in progress for the further extension of the line to Portland.

*Oregon Improvement Co.*—This company has purchased the Olympia & Tenino R. R., narrow gauge, running from Olympia to Tenino, Wash., 12 miles. The line will be changed to standard gauge.

### Projects and Surveys.

*Oregon Railway Extension Co.*—This company has filed articles of incorporation authorizing it to construct about 3,000 miles of railway in the Northwest. The proposed lines are as follows:

Portland to Astoria, 100 miles, with branch lines from Columbia City to Forest Grove; Alto Station, in Columbia County, Wash., to Wallula, by way of Estes, 33 miles: Estes to Grange City, Wash., 22 miles; Texas Ferry, Whitman County, Wash., to Dutch Flats, 85 miles; Centerville to Cold Springs Station, Ore., 35 miles; Pendleton to Heppner, Ore., 40 miles; Umatilla to Prineville, Ore., 165 miles, with a branch to John Day, 100 miles, and another to the mouth of the Des Chutes River, 120 miles; Walla Walla, Wash., to Butte, Mont., 450 miles; Lewiston to the mouth of the Little Salmon River, in Idaho, 100 miles; La Grande to Wallowa Valley, Ore., 70 miles, with a branch to Lewiston, I. T., 65 miles; Walla Walla to Waitsburg, by way of Mill Creek Valley and Dixie, 22 miles; Portland to Blaine, Wash., by the way of Vancouver and the Puyallup River, 290 miles, with branches in Washington as follows: In Lewis County, 90 miles; from the mouth of the Cowlitz River down the north bank of the Columbia River to the Pacific Ocean, 72 miles; Olequa to the headwaters of the Cowlitz, 90 miles; Centralia to Gray's Harbor, 65 miles; Tenino to Olympia, 18 miles; branches along the Nesqually River, 48 miles; along the Puyallup River, 52 miles; Puyallup River to Tacoma, 18 miles; from a point near the confluence of the White and Green Rivers to an intersection with the Northern Pacific, 22 miles; from the confluence of the Duwamish, White, and Black Rivers to Franklin, 24 miles; along the Snoqualmie and Snohomish rivers, 90 miles; along the Skagit River, 50 miles; along the Nooksack River, 45 miles; Port Townsend to Centralia, 120 miles; Elberton to Idaho, 40 miles; Connel to Seattle, 225 miles; Elgin, Ore., to the head of Wallowa River, Ore., 60 miles; Baker City, Ore., up Powder River Ore., 40 miles; Clarnie to Silverton, Ore., 75 miles; Latah, Wash., to the Wenatchie River, Wash., 195 miles.

*Oregon.*—Incorporated in Oregon to build lines of railway from Portland or East Portland to the California State line, and from Portland to Arlie, Ore., with a branch from Arlie to some other point.

*Calgary & Edmonton.*—Surveys are now in progress for the proposed railway from Calgary, Alberta, to Edmonton, 210 miles. Alexander Stewart is the engineer in charge.

### FOREIGN.

*Interoceanic.*—The Morelos division has been opened for traffic to Jojutla. On the line between Perote and Jalapa, tracklaying has been completed to a point 1.8 miles beyond Las Vegas. It is hoped to have the line completed to Jalapa and in operation by June. The tunnel between San Miguel de Soldado and Banderilla is nearly completed.—The grading is completed for 24 miles on the section from Vera Cruz to Jalapa, and the rails are laid for a distance of about 13 miles.—The contractors have obtained a new concession for a line to start from a point between the present stations of Compañia and Ayotla and to rejoin the old line at San Martin. This line will be 40 miles in length, and will give a total length of line between this city and Puebla of 83 miles. Two parties of engineers are at present in the field making the surveys for this addition to the system.

*Jamaica.*—A press dispatch says: A syndicate was completed Jan. 1 to purchase from the Jamaica government 65 miles of railroad, extending from Kingston, the present capital, to Porne, and from Spanishtown, the old capital, to Ewarton. The price was $4,000,000, of which $500,000 was paid down, the rest to remain on bond and mortgage. The syndicate has contracted to extend the lines, making a total length of the road when completed 185 miles. The road will be standard gauge, 4 ft. 8½ ins., and the present English equipment changed to American. Two parties of engineers have been in the field for several months, one on each extension. No contracts for building have yet been given out, although bids for steel rails have been obtained from both American and English firms. Thus far the lowest bid is from Birmingham, Ala. According to the terms of agreement not less than 12½ miles of the road are to be finished each year. There will be a number of bridges and tunnels. The government gives to the syndicate 65,000 acres of land and guaranteed bonds to the amount of $40,000 per completed mile. The proposed route is often through beautiful groves of oranges.

*Matamoros & Laredo.*—A press dispatch from Laredo Tex., dated April 18, says:

A committee representing the Laredo Board of Trade, consisting of Charles F. Tager and J. F. Mullaly, leave this city to-morrow for Rio Grande City, Tex., and Carnago, Gueners, and Matamoros, Mex., in the interest of the speedy construction of a line from this city to Matamoros at the mouth of the Rio Grande. The Mexican National Railway owns and operates a narrow-gauge tap from Matamoros, on the Mexican side, to within 18 miles of Rio Grande City, which they have agreed to sell on 40 years' time. The towns along the line all agree to put up a liberal bonus, and it is understood that the gauge of the line already built is to be changed to standard gauge, and completed on this side of the river from Rio Grande City to this point.

*Mexico.*—The following summary of railway enterprises is given by President Diaz in his last message:

Among railroad events the most important is undoubtedly the completion of the Mexican Central's line, 442 kilos., between San Luis Potosí and Tampico. Besides placing an important seaport in communication with the rest of the country, this line will serve fertile regions, such as the Huasteca district, and will before long stimulate the development of their resources.—The Interoceanic Co. is working with energy and success on the Vera Cruz-Jalapa section, the heaviest portion of the whole line on account of its rapid descent.—The Monterey & Gulf has completed its connection with the lines of the International & National, and has besides pushed its main line as far as Linares. This company has constructed 256 kilos. within a year, giving the capital of Nuevo Leon a connection by two railways with this city and with the American frontier. It is prosecuting the construction of its line to Victoria and Tampico.—Much active work has been done on the Cordoba & Tuxtepec Agricultural Ry., for in the space of 14 months 37 kilos. of line, including heavy bridge work and tunnelling, have been completed.—On the Mexican Southern (Puebla to Oaxaca) 149 kilos. of embankment between the cities of Puebla, Tehuacan and Tecomavaca have been completed. Large quantities of material having arrived, the line will soon be placed in working order, and it may be safely stated that the city of Oaxaca will soon have rail connection with the capital of the Republic.—The Mexican Pacific Co. has begun work energetically on the railway which will connect the remote State of Chiapas with that of Tabasco, by means of a line between the ports of Tonalá and Frontera, thus affording another interoceanic channel of communication. The company has begun work at the port of Tonalá by building a pier. This pier which is 274.2 metres long is already in use.—Work on the Tehuantepec Isthmus Ry. is progressing steadily. At the southern end the line has reached the Chivela Pass, where three tunnels are being driven. On the Maravatio and Iguala line 45 kilos. have been completed, and work is advancing on this line, which will serve important mining districts.—The concessionaire of the Northwestern R. R. in the Valley of Mexico, running between this city and Tizayuca, where it will connect with the Hidalgo Ry., has completed the works of superstructure for a distance of 31 kilos., and the works of substructure already approach the capital. The concessionaire of the Valley of Mexico Ry. has completed 13 kilos. of the line between this city and San Angel, via Tacubaya and Mixcoac. Lastly, the Mexican companies engaged in building railways in Yucatan, though not possessing the means of prosecuting their undertakings at the same rate as other companies, are none the less entitled to commendation for their constancy.

## RAPID TRANSIT.

**Electric Railways.**—At Greenfield, Mass., a franchise has been granted for an electric railway to Turner's Falls.

The Geneva Electric Ry. Co., of Geneva, N. Y., has been incorporated, and has applied for a franchise.

The electric railway from Brooklyn, N. Y., to Coney

Island has been opened for traffic. It is on the Thomson-Houston system. President, Gen. H. W. Slocum.

The Amsterdam St. Ry. Co., of Amsterdam, N. Y., will adopt electric traction. Thomas D. Mosscrop, of Philadelphia, Pa., has made a proposition to build an electric line from Amsterdam to Rockton.

The Tonawanda & Wheatfield Electric Co. will build a line between Tonawanda and Buffalo. President, Samuel B. Hard; B. B. Hamilton, of Buffalo, is interested. The Thomson-Houston system will be adopted.

The Street Committee, of Buffalo, N. Y., has reported in favor of the overhead wire system for the Niagara St. line.

The Citizens' Traction Co., of Pittsburg, Pa., will build an electric line through Sharpsburg, as an extension of its cable road.

The Metropolitan Ry. Co., of Washington, D. C., is experimenting with a storage battery car on the system of C. O. Mailloux.

The Fort Wayne & Elmwood Ry. Co., of Detroit, Mich., is running a storage battery car built at the Pullman Car Works and equipped by the Woodward Storage Battery Co., of Detroit.

The Leavenworth Electric Ry. Co., of Leavenworth, Kan., has been organized by J. A. Bovard, Kansas City; S. S. Nelley, J. R. Braidwood, Robert Garrett, Leavenworth; John H. Borard, Kansas City. Capital stock, $100,000.

**Street Railways.**—The York Road Ry. Co., of Baltimore, Md., proposes to adopt some system of mechanical traction.

The Judson Pneumatic St. Ry. Co., of New York, expects to have its system on the Brightwood line in Washington, D. C., in operation shortly. The Johnson Co., of Johnstown, Pa., has the contract for the track rail; Wm. Wharton, Jr., & Co., of Philadelphia, Pa., for the slot rail; Ingersoll Rock Drill Co., of New York, for the compressing plant; the American Tube & Iron Works, of Middletown, Pa., for the rotating cylinder; Austin, Cochran & Co., for the castings and yokes for the conduit, and Christie & Low, of Omaha, Neb., are the general contractors.

The Chattanooga Land, Coal, Iron & Ry. Co., of Chattanooga, Tenn., has awarded a contract for 2 miles of street railway to W. C. Durand.

The Bluff City St. Ry. Co., of Alton, Ill., has been organized, with a capital stock of $20,000. The road is to be built this summer.

The 22nd St. Ry. & Omnibus Co., of Chicago, has been organized by C. F. Schumacher, John Burgraff and Henry Schlett. Capital stock, $500,000.

The Cream City Passenger Ry., of Milwaukee, Wis., has been purchased for $900,000 by John W. Chalfant, A. M. Byers and A. W. Mellon, of Pittsburg. The line is 23 miles long.

The Capital City St. Ry. Co., of Little Rock, has been organized, with Geo. B. Allis at its head, and has acquired the Little Rock St. Ry. and the Citizens' St. Ry. The company will make extensive improvements. J. Bradford is Superintendent.

The Denver Extension Ry. Co., of Denver, Col., has been incorporated by Rodney Curtis, John Evans, Frederick A. Keever and others. Capital stock, $500,000.

The West Side Rapid Transit Co., of Salt Lake City, Utah, has been incorporated to build 20 miles of line, using electricity or other motive power. Construction will be begun at once. President, T. A. Davis; general manager, M. F. Sturges. Capital stock, $300,000.

The Oregon City St. Ry. Co., of Oregon City, Ore., has been incorporated by E. M. Atkinson, T. L. Charman, N. O. Walden and others. Capital stock, $25,000.

## HIGHWAYS.

Rhode Island.—A bill has been passed authorizing the town of South Kingstown to incur a debt equal to 4 per cent. of its valuation, with a recommendation of passage in concurrence. The object of the measure was to enable the town to pay for macadamizing its roads. The contracts were let by order of the people, but they had not money enough to carry out the work.

Indiana.—The vote taken recently at Indianapolis on the proposition for the purchase of toll roads by the County Commissioners resulted in favor of the purchase of 16 out of the 18 roads included in the proposition.

Ohio.—Notice has been given that a petition will be presented to the Commissioners of Cuyahoga Co., at Cleveland, at their session to be held on the first Monday of June, 1890, praying for the establishment (or extension) of a county road along the following route in said county: Beginning at the west end of the Warrensville and Bedford town line road; thence westerly through the lands of Osborn Rheinhart, the Cleveland & Canton Ry. Co., the Cleveland & Pittsburg Ry. Co., and Thomas McCracken, to the easterly end of a county road known as the Mc. Bride road.

South Carolina.—The county commissioners at Charleston have called for bids for the construction of 1,500 sq. yds. of granite block roadway on the main road north of the city boundary line. The county commissioners, with the sanction of the Charleston delegation to the Legislature, will hereafter waste no money in attempting to keep in repair the six miles or more of plank road which leads from the city into the country. In the Charleston Co. appropriation bill, passed at the legislative session of 1889, was a clause authorizing the county commissioners to expend $3,000 in repairing the main road leading from the city. No mention was made of the kind of road, and the commissioners, after considering the matter carefully, decided to repair the plank road by substituting a substantial granite block roadway. The commissioners hope to be able to build a permanent roadway in time up to the county line, which extends as far as the Six-mile House. It will, of course, depend upon the Charleston delegation to the Legislature how long it will take to finish the road. It is said that no more money will be expended in repairing the plank road, but that the annual appropriations hereafter will be devoted to the construction of a stone roadway. The bids for the work contemplated this year will be opened on May 2.

Kentucky.—A large number of turnpike and highway companies have applied to the Legislature for incorporation: The Newtown & Little Elkhorn Turnpike Co., the Nicholasville & Bethel Turnpike Road Co.; the Camp Creek, Oakland & Powersville Turnpike Co.; the Avenstoke & Wilson Creek Turnpike Road Co.; the Mitchellsburg & Rolling Fork Turnpike Road Co.; the Jeffersontown & Seatonville Turnpike Road Co.; the Vanelburg & Stouts Lane Turnpike Co.; the Springfield & Cartwrights Creek Turnpike Road Co.; the Silver Creek, Scaffold Cave & Mt. Vernon Turnpike Co.; the Beaver Lick & South Fork Turnpike Co.; the Buckeye & Poor Ridge Turnpike Co.; the Burlington & Normansville Turnpike Co.; the Burlington & Union Turnpike Co.; the Campbellsville, Elkhorn & Mannsville Turnpike Road Co; the River View & Capro Turnpike Road Co.; the Shepherdsville & Pitts Point Turnpike Road Co.; the East Fork Turnpike Road Co.; Camdenville & Johnsonville Turnpike Road Co.; Wallace Mill Turnpike Road Co.; Harrod's Run Turnpike Road Co.; Bell & Harlan Co. Turnpike Road Co.; Brusby Fork & Scrubgrass Turnpike Road Co.; Jones' Mill & Rocky Branch Turnpike Co.; Chadwicks' Ferry Turnpike Co.; Little Jordan Turnpike Road Co.; Persimmon Grove & Grant's Lick Turnpike Road Co.; Junction Turnpike Co., and the Cowan Station & Battle Run Turnpike Road Co. The act incorporating the Nortonville & Clear Creak Turnpike Co. has been passed. The Sanders Turnpike Road Co. has been incorporated by Samuel Llewellyn, Peter Llewellyn, and G. W. Deatherage, of Sanders, Ky. Capital stock, $10,000.

## WATER-WORKS.

### NEW ENGLAND.

***Derry Depot, N. H.***—The water company will soon commence operations.

***Methuen, Mass.***—At a recent special town meeting of the committee appointed to consider the matter of introducing a system of works, an unfavorable report was made. The committee was reappointed, and instructed to make further investigation and report at a future meeting.

***Springfield, Mass.***—An exhaustive report has been submitted to the Water Board on the question of improving the city's water supply, by Percy M. Blake, of Hyde Park, Mass. The estimated cost of carrying out the plan as proposed is $300,000.

***Newport, R. I.***—The Water-Works Co. is engaged in laying mains to connect with those of the private system on the government reservation at Fort Adams, which will hereafter receive its water supply from the same source as this city. To place the water within the boundary of the reservation the company will be obliged to lay about 2,800 ft. of 6-in. pipe.

### MIDDLE.

We have received official information regarding improvement and additions to be made, or contemplated, to the following works this season:

***Malone, N. Y.***—Laying about 4,000 ft. of 10, 6 and 4-in. pipe, and setting 12 new valves. Superintendent, George Sabin.

***Johnstown, N. Y.***—Laying 8,000 ft. of 6 and 4-in. pipe setting 14 new hydrants and 16 new valves. J. J. Buchanan is Superintendent.

***Poughkeepsie, N. Y.***—Laying 2,500 ft. of 6-in. pipe, placing 150 new meters, and setting 10 or 12 new hydrants, and 6 or 8 valves. Superintendent, Charles E. Fowler.

***Newburgh, N. Y.***—Laying 5,585 ft. of 6 and 4-in. pipe, setting 10 new hydrants, and seven 6-in., and ten 4-in. valves. Superintendent, W. C. Miller.

***Flushing, N. Y.***—Setting 5 new hydrants and 6 new valves, and laying about 3,600 ft. of new pipe. The above has been contracted for. Superintendent, G. A. Roullier.

***Auburn, N. Y.***—Laying 3,300 ft. of 6 and 4-in. pipe and setting 5 new hydrants and seven new valves. The number of meters to be placed has not been decided upon. Superintendent, Nelson B. Eldred.

***Albany, N. Y.***—"Hope to set a large number" of hydrants. George W. Carpenter is Superintendent.

***Cohoes, N. Y.***—Laying about 1,100 ft. of 12, 8 and 6 in. pipe, setting 25 new hydrants, and 50 new valves. Superintendent, A. T. Kniffin.

***Utica, N. Y.***—A few meters will be set, and a small amount of new pipe will be laid. Superintendent, C. W. Pratt.

***Long Branch, N. J.***—A pressure regulator is to be placed upon the Seabright stand-pipe, two new hydrants, and six new valves, will be set, and about 3,000 ft. of 6-in. pipe will be laid.

***Bradford, Pa.***—Laying about two miles of 8, 6 and 4-in. pipe, setting 16 new hydrants, and 30 4-in., 1 6-in. and 1 8-in. valve. Superintendent, C. J. Lane.

***Johnstown, Pa.***—Five miles of new mains, 3 miles of 36-in. and 2 miles of 4-in., will be laid, and 5 new hydrants, and 10 new valves will be set.

***Lock Haven, Pa.***—Three miles of 4 and 6-in. pipe will be laid, and 3 new hydrants will be set.

***Erie, Pa.***—Thirty new hydrants, and 40 new valves will be set, and 4 miles of new mains, 30 to 4-ins. in diameter will be laid. Secretary, B. F. Sloan.

***Williamsport, Pa.***—About 2 miles of new mains will be laid, and 20 or more valves will be set.

***Middletown, N. Y.***—Sealed proposals will be received by the Board of Water Commissioners until May 12, for furnishing materials and constructing a reservoir and pipe line for an additional water supply.

Plans may be seen, and specifications and blank proposals obtained, at the Commissioners' office, on and after April 24, 1890. Address Isaac R. Clements, President Board of Water Commissioners.

***Tonawanda, N. Y.***—The North Tonawanda Council has decided to extend the water mains from Payne Ave. to Niagara St., and down the latter to Goundry St.

***Cohoes, N. Y.***—The bill authorizing the City Council to issue $25,000 of bonds for improvements has passed the Senate.

***Niagara Falls, N. Y.***—The Niagara Falls Water-Works Co. has been asked to give an option on their plant, good until May 1, to the U. S. Water-Works Co., of Tonawanda. The capital stock of the intended purchasers is $2,000,000, and it is understood that if the purchase is made a plant will be erected about four miles up the river of sufficient capacity to supply towns up and down the river. New York capitalists are said to be interested in the movement.

***Fayetteville, N. Y.***—Engineers have been making examinations with a view to building works. Water can be brought from the Todd Farm, about ½ mile east of the village, with sufficient force to be thrown over any building in town.

***Fairport, N. Y.***—The Crystal Rock Water Co., formerly W. A. Parce & Co., has been organized as a stock company with a capital stock of $20,000. The incorporators are; Walter S. Hubbell, of Rochester; Levi J. Deland, Fred S. Todd, Joseph H. Snow, and Walter A. Parce, of Fairport.

***Chateaugay, N. Y.***—Senator W. C. Stevens' bill has passed the Senate incorporating the "Chateaugay Water. Works."

***Keyport, N. J.***—The Town Council has requested the town to vote at the coming election for or against providing water-works, etc., for protection against fire.

***Burlington, N. J.***—Superintendent George A. Allinson informs us that 1,200 ft. of 6-in. pipe will be laid, and that 2 new hydrants, and 2 new valves, will be set, this season.

***Elizabeth, N. J.***—About 2 miles of 10, 6 and 4 in. mains will be laid, and 6 new hydrants, 12 new valves, and 6 new meters, will be set. Address L. B Battin.

***Beaver Falls, Pa.***—It is reported that Mr. Holly, of the Holly Mfg. Co., of Lockport, N. Y., has been negotiating for a contract to supply the water-works with his system.

***Cambridge, Md.***—At a recent meeting of the Town Council, it was decided to contract with Deitrich & Clark, of Baltimore, Md., for building the water-works on terms heretofore agreed upon. Professor Lowry has pronounced the water good, and two more artesian wells are to be sunk near the present one, which has a natural flow of 800 galls. per hour.

***Bel Air, Md.***—Civil Engineer A. R. T. Lackie, of Baltimore, Md., has sent us the following:

James H. Harlow & Co., of Pittsburg, Pa., were awarded the contract for constructing works for the Belair Water & Light Co. on April 16. Work is to be commenced on April 28, and completed about Sept. 1. The estimated cost is $30,000. Water will be conveyed by gravity from Wallace springs to a reservoir. President, O. S. Lee; Treasurer, Richard Dallam; Secretary, George R. Cairnes. Designing and Constructing Engineer, A. R. T. Lackie. Population, 1,500.

***Washington, D. C.***—Col. George H. Elliott's report of the progress made on the work of increasing the city's water supply during the month of March, shows the practical completion of the work of laying the new 48-in. main from the reservoir through the city. It presents a money statement, indicating a balance on hand at the end of the month of $190,237.33, of which $26,506.20 is covered by existing contracts, leaving an available balance of $163,713.13, which is the sum that has been saved in the execution of the work from the amount appropriated.

### SOUTHERN.

***Clifton Forge, Va.***—The incorporators of the Clifton Forge Water Co. are: B. W. Branch and E. A. Saunders, of Richmond, and E. M. Nettleton, of Clifton Forge, and others. The company will supply water to Clifton Forge and the adjacent country. The minimum capital stock may be $25,000, and the maximum $100,000.

***Lexington, Va.***—The Glamorgan Co., of Lynchburg Va., has been awarded the contract for furnishing the pipe for the new works. James Allen, of Lynchburg is the contractor.

*St. Albans, W. Va.*—The City Council granted exclusive franchises for electric lights and water-works to Robert T. Oney, of Charleston, W. Va., on April 19.

*Charlotte, N. C.*—About 1¾ miles of 6 and 4-in. pipe will be laid this season, and 20 new hydrants, and 8 or 10 new valves, will be set.

*Henderson, N. C.*—We have received the following official information:

Woltmann, Keith & Co., 11 Wall St., New York, have been granted a 40-years franchise for constructing works. There will be 7½ miles of pipe, 12 to 4 ins. in diameter, 68 hydrants and 2 pumps of 1,000,000 galls. capacity each. The town will pay a hydrant rental of $2,720 per year; additional hydrants, $35. The stand-pipe will be 15 ft. in diameter by 130 ft. high.

*Blacksburg, S. C.*—It is reported that the Blacksburg Land & Improvement Co. has increased its capital stock to $50,000. Also, that it has purchased the Seven Springs on Whitaker Mountain, and a spring on the Mack Byers Place, and will establish works to supply Highland Place, Round Hill and Overlook Place.

*Americus, Ga.*—The city intends to construct a system of works. Address J. B. Felder, Mayor.

*Savannah, Ga.*—It is reported that the subject of increasing the facilities for supplying water to the city has been fully discussed by the committee of the whole, and that an expert from Memphis has been invited to visit the city and inspect the wells and water-works system and present the result of his investigation to the council.

*Augusta, Ga.*—Wm. Bennett informs us that 1,200 ft. of 6-in. pipe will be laid, and that four new hydrants, and four new valves, will be set this season.

*Sylacauga, Ala.*—Address D. T. Parker or S. E. Noble for information regarding the projected works.

*Shelby, Ala.*—The Alabama Coal & Iron Co. proposes to construct works.

*Jacksonville, Ala.*—Extensions and improvements are contemplated. The capacity of reservoir will probably be largely increased, and mains laid to supply the increasing area of the town. Address G. B. West, General Manager of the Jacksonville Mining & Mfg. Co.

*Canton, Miss.*—A contract has been made with the New Orleans Artesian Well Co. to begin work on the unfinished well at once. It is thought water will be reached within 100 ft.

*Morristown, Tenn.*—O. C. King is reported as stating that the city has granted a franchise to J. G. Martin, President of the Morristown & Cumberland Gap R. R. to establish works.

*Barboursville, Ky.*—A bill has been introduced into the legislature to incorporate the Barboursville Water Co.

*Paris, Ky.*—We have received the following information from the City Clerk:

The contract for constructing works has been let to Wheeler & Parks, of Boston, Mass., provided it is voted upon favorably by the people on the 19th. "I do not think there is any doubt in regard to its carrying." Work is to be commenced within two months, and completed within 10 months. Water will be pumped to a stand-pipe. Population, 8,000. The name of the company will be the Mystic Valley Water Co.

*Prestonburg, Ky.*—A bill has passed the house incorporating the "Prestonburg Water-Works."

*Louisville, Ky.*—Work will soon be commenced on a new stand-pipe for the Louisville Water Co., to take the place of the one destroyed by the tornado. Bids are now being solicited for the work as a whole, and for furnishing the iron. Chief Engineer Charles Hermany states that a bid for the work completed will probably be accepted. A new set of pumping machinery is to be purchased.

*Ashland, Ky.*—Address H. Herrman for information regarding the Ashland Water Supply Co.—It is reported that the Ashland Improvement Co. has purchased about 2,000 acres of land, and will improve and construct works. Reported capital stock, $3,000,000.

*Louisa, Ky.*—A bill has been introduced into the Legislature to incorporate the Louisa Water Co.

*Somerset, Ky.*—City Clerk J. K. Sewall has sent us the following information:

No contracts have been awarded. They will be let within 60 days. Authority to establish works has been granted by the Legislature, and it is proposed to put the enterprise under way at once. The City Council is open for propositions, and can obtain a charter for a company desiring to incorporate. The estimated cost is $40,000 to $50,000. Address Major S. Whinery for information. The proposed plan is to pump water from the head waters of the creek to a reservoir. Population, 3,500.

### NORTH CENTRAL.

The following information has been received from officials, stating the work contemplated, or decided upon, in improving and extending the following works during the coming season:

*Defiance, O.*—Laying 3,400 of 8-in. pipe, and setting 6 new hydrants and 2 new valves.

*Circleville, O.*—About one mile of 6-in. pipe will be laid, and 6 new hydrants will be set.

*Columbus, O.*—Twenty-seven miles of new pipe, 16 to 4 ins. in diameter, will be laid, and 152 new hydrants, and 272 new valves, will be placed. The number of meters to be set has not been decided upon. A complete new pumping station is to be constructed and two Gaskill triple expansion engines, each of 7,500,000 gall. capacity, will be erected. Address A. H. McAlpine, Chief Engineer and Superintendent.

*Toledo, O.*—Forty to 50 meters, 20 hydrants, and 25 valves will be set this season, and about 5 miles of 12, 8 and 6-in. pipe will be laid.

*Xenia, O.*—Two hundred new hydrants, 170 valves, and 100 new meters, will be set this season, and 25 miles of 14 to 8-in. pipe will be laid. Address John P. Martin.

*Troy, O.*—"May put in steam power engine." Three new meters will be set. Secretary, I. A. Price.

*Caldwell, O.*—A bill has been introduced into the House to authorize the town to issue bonds for securing fire protection.

*Harrison, O.*—A bill has been introduced into the House asking for authority to vote on a proposition to issue $35,000 of bonds for water-works, etc.

*Zanesville, O.*—The bill authorizing the city to issue $50,000 of extension bonds has passed the Senate.

*Wellsville, O.*—A. S. Foge, Superintendent, has sent us the following:

About 4,000 ft. of 4-in. pipe will be laid, and 6 new hydrants, 8 new valves, and 10 new meters, will be set.

*Wooster, O.*—A small amount of 4 and 6-in. pipe will be laid this season, and 4 new hydrants, 6 valves, and 3 meters will be set. Z. Potter is the Superintendent.

*East Liverpool, O.*—The bill which will permit the city to increase its bonded indebtedness from $48,000 to $90,000 has passed the Senate. The $90,000 will be used for additional water-works improvements. A large reservoir will be erected on Houston Hill, about 400 ft. above the level of the city.

We have received official information regarding the extensions and improvements to be made, or contemplated, during this season, in the following places;

*Terre Haute, Ind.*—Five miles of 16 to 6-in. pipe will be laid, and about 60 new hydrants and 30 new valves will be set. A. C. Chadwick is Secretary.

*Flint, Mich.*—New works are now being constructed above the city. Water will be pumped from the Flint River. The new pump will have a capacity of 4,000,000 galls. About 2 miles of new pipe will be laid,

*Bay City, Mich.*—Two miles of 6 and 8-in. pipe will be laid, and 12 new hydrants, 20 new valves, and 30 new meters, will be placed. Superintendent, E. L. Dunbar.

*West Bay City, Mich.*—About 3,000 ft. of new mains will be laid, and 6 or 8 new hydrants, and 3 or 4 new valves, will be set.

*Milwaukee, Wis.*—Fifteen miles of 16 to 8-in. pipe will be laid, and 1,000 meters, 80 valves, and 125 hydrants, will be set. A new 18,000,000 gall. pumping engine will be erected, and a new intake pipe will be laid. The contracts for pipe-laying and hydrants have been let.

*Detroit, Mich.*—The Detroit Pipe & Foundry Co. has been awarded the contract for furnishing the city with 3,240 tons of 36, 30, 24 and 16-in. cast iron pipe, by Secretary Case.

*Coldwater, Mich.*—The question having been raised as to the legality of the recent vote for bonding the city for $70,000 for constructing works, on account of the notice not having had the necessary legal publication, the Common Council has ordered another election, which will be held on May 5.

*Belvidere, Ill.*—The following is from F. B. Sands:

The prospect is good for having works constructed, and it is probable that they will be put in this season. The contemplated plan is to pump water from artesian wells to a stand-pipe.

*Kenilworth, Ill.*—(A new town, near Evanston.) Work has just been commenced on a system of works by George C. Morgan, of Chicago, Ill.

*Pana, Ill.*—The City Council has made arrangements to have several experimental tubular wells put down.

*Antigo, Wis.*—The following information has been received from Edward La Londe, City Clerk:

The Common Council resolved on April 16 to grant a franchise to some suitable company for constructing and operating a system of works. The proposed plan is to put in about 5 miles of mains, and the necessary hydrants. Population, 4,500. The proposed source of supply is wells. The Council will meet on April 30 to consider propositions from parties desiring to put in a plant.

*Antigo, Wis.*—The Common Council has called for bids to furnish a water-works system with 5 miles of pipe.

*Ripon, Wis.*—J. M. Carson, of Danville, Ind., has closed a contract to build new works to cost $60,000.

### NORTHWESTERN.

*Rock Rapids, Ia.*—M. M. Camp, of New Haven, Conn., has arrived to superintend the construction of the city's works. The Chicago Hydraulic Pipe Co. now owns the franchise, and will push the work to completion as rapidly as possible. Work has been begun on the trenches.

*Little Falls, Minn.*—We have received the following information from W. W. Fuller:

Harrison & Hawley, of St. Paul, Minn., have been awarded the contract for constructing works. Work was commenced on April 20, and is to be completed about July 1. Estimated cost, $45,000. Water will be pumped direct to mains from the Mississippi River. The officers of the Little Falls Electric Light & Water Co. are: President, S. Stall; Vice-President, John A. Berkley; both of St. Paul; Secretary and Treasurer, J. B. Hutchins. Population, 3,000.

*McPherson, Kan.*—Superintendent A. Grosse informs us that the works are for sale, and that they are "open for bids until May 5."

*Ainsworth, Neb.*—Bonds having been sold, the town has called for bids for constructing works, to have a daily capacity of 400,000 galls. Water will be pumped to a stand-pipe.

*Hay Springs, Neb.*—The following information is from M. Finch, Village Clerk:

The town will advertise for proposals early in May; bids to be accompanied by plans and specifications. Bonds will be issued as soon as a contract is made. The principal object is to secure water for fire protection. A large tank will be built on a hill about 100 ft. above the town, from which mains will be laid through Main St. Water will be pumped from a well. Five or six hydrants will be set. Population, 800.

*Iroquois, So. Dak.*—Artesian well bonds for $2,400 have been sold. The well is now down about 150 ft.

*Miles City, Mont.*—B. Ullman, Superintendent of the Water & Electric Light Co., has recently purchased all the material necessary for constructing works in that city, which will supply 1,000,000 galls. a day. The contract for construction has been awarded to a St. Paul party.

*Helena, Mont.*—The consolidated company is now laying 8 miles of new mains.

### SOUTHWESTERN.

*Lufkin, Tex.*—It is reported that Henderson & Kurth are erecting a system of works.

*Lott, Tex.* (A new town, near Waco, Tex.)—J. W. Mann, J. I. Moore and others, have incorporated the Lott Water Co., to construct works. Capital stock, $30,000

*Dallas, Tex.*—The purchase of a new 18,000-gall. vertical pump is projected.

*Vernon, Tex.*—The Vernon Ice, Light & Water Co., has been incorporated by D. A. Turner and others, to build works, etc. Capital, $60,000.

*Denver, Colo.*—Woodbury and Moulton, of Portland, Me., are offering $200,000 of the Denver Water Co.'s first consolidated mortgage 7 per cent. gold bonds for sale.

*Boulder, Colo.*—City Engineer Oliver is engaged in making surveys for the new works. The new reservoir will be north of and 100 ft. higher than the present one, over the hill, in Sunshine Cañon, and will give a pressure of about 110 lbs. to the sq. in., and hold 5,000,000 galls. of water. It is probable that the new source of supply will be in the mountains near the mouth of Four-Mile Creek, or the Boulder, and that the Omaha system of reservoirs will be used. The work on the new system is to be done by home labor.

### PACIFIC.

*Kent, Wash.*—Articles of incorporation of the Farmers' Water Co. have been filed with the County Auditor, by S. D. McMillan, A. B. Farnsworth, George Wood, Robert Ramsey, and George R. Leese. The objects of the company are to supply the residents of Kent with fresh water for domestic use and other purposes. Capital stock, $10,000, divided into 100 shares. The trustees of the company are the incorporators.

*Seattle, Wash.*—Plans for the foundation for the new pumps have been prepared by Assistant Engineer Erickson.

*Los Angeles, Cal.*—The final lines of the new water system will be established in a few days, when the work will at once be pushed to completion. The estimated cost of the new works is $2,000,000.

*Reno, Nev.*—The Reno Water, Land & Light Co. is putting down new water and gas mains in many portions of that town.

### CANADA.

*Sault Ste. Marie, P. Q.*—Bids will be received until May 12 for the purchase of debentures to the amount of $105,000, running 30 years, interest 5 per cent., payable half yearly. Address Hy. C. Hamilton, Mayor.

*Montreal, P. Q.*—The Superintendent has submitted a list of streets in which he thinks it would be well to lay new pipes during the present summer. The estimated cost of the work is $44,000.

*St. Thomas, Ont.*—City Engineer James A. Bell has kindly sent us the following information:

A by-law has been carried appropriating $125,000 for remodeling the water works. It is the intention to remove the present works to a point on Kettle Creek, above the city, to impound the waters of the creek there, and after filtration to pump direct into the mains. The estimates call for 15 miles of new pipe, 104 hydrants, and 165 valves, beside new engines, boilers, buildings, etc.

*Toronto, Ont.*—The following is an estimate of the expenditures to be made during 1890:

| | |
|---|---|
| Meter and machine shop | $10,791 |
| Maintenance distribution | 24,000 |
| Main pumping station | 77,416 |
| Rose Hill and High Level | 4,500 |
| High Level pumping reservoirs station | 6,500 |
| St. Alban's station | 9,244 |
| Total | 132,451 |

### PROJECTS.

Wautauga, Tenn.; Wautauga Water Co.—Winside, Neb.—Murfreesboro, Tenn.; N. C. Collier, President, Murfreesboro Ice Co.— Darlington, S. C.

### ARTESIAN WELLS.

*Lancaster, Pa.*—A well being sunk at the Penn Iron Works has reached a depth of 2,000 ft., but water in sufficient quantity has not yet been secured.

*Waco, Tex.*—J. J. Moore and others have incorporated the Artesian Water Power Co. Capital stock, $30,000

### IRRIGATION.

*Montana.*—The survey for the proposed irrigating canal in the upper Yellowstone valley has been completed. The length of the canal required would be about 11 miles, and its cost will be about $19,000.

*Altamonte Springs, Fla.*—Charles Whittier, of Boston, has erected an irrigating plant upon his grove at this place. The plant consists of an upright tubular boiler, with horizontal steam pump, and about 2,700 ft. of pipe and hose. For the first three days after starting the machinery it discharged upon the groves 20,000 galls. per day. The water is taken from a lake adjoining the grove.

*Dakota.*—The work of surveying the Dakotas for artesian water has been inaugurated under the auspices of the U. S. Government. The Secretary of Agriculture has appointed Professor Culver, of the Vermilion University, chief examiner for both of these states. He will be assisted by Professor Stephen G. Updyke, of Brookings Agricultural college, who will have charge of the surveys for South Dakota, east of the Missouri River, and Professor Bailey, of the School of Mines and Mining at Rapid City, for South Dakota, west of the river. These appointments have been made upon the recommendation of the South Dakota delegation. Meantime, upon the recommendation of Senator Casey and Congressman Hansbrough, T. S. Underhill has been appointed assistant surveyor for North Dakota, east of the river, and another surveyor, yet unnamed, will be appointed for the same state west of the river. Col. John Hinton, of New York, and Gen. A. B. Nettleton, of Minneapolis, will have charge of this irrigation business at the Department of Agriculture in Washington, D. C.

## SEWERAGE AND MUNICIPAL.

**Sewerage.**—At Swanton, Vt., it has been decided to build a sewer in Broadway to the river.

The three lowest bidders for sewer pipe at Manchester, N. H., were the Portland Pipe Co., Fiske, Holman & Co. (Akron pipe), and Knowles, Taylor & Anderson.

The taxpayers of White Plains have decided against the use of a siphon in the outlet sewer. A year ago, when the introduction of a sewerage plant was projected, the committee having the matter in charge requested the State Board of Health to send a competent engineer to plan a system of sewerage for the village. W. B. Landreth, of Schenectady, was appointed. His original plan, approved by the State Board of Health, did not call for a siphon beneath the bed of the Bronx River. As the work advanced it was found that the bed of the disposal works had been constructed 3 ft. too high, and that if the outlet pipe was was to go beneath the Bronx a siphon would be required. William Worthen and Rudolph Hering, engineers, of New York City, reported that a siphon should not be used if it could be avoided. The sewer system, complete, will cost the village about $225,000, to be paid for within 30 years.

The city committee of the New York Senate has reported favorably a bill authorizing the city of Rochester to issue $1,000,000 of bonds for the construction of a trunk sewer on the east side of the Geneseo River. A number of 9, 12 and 15-in. pipe sewers are to be built.

At Lakewood, N. J., contracts will be let shortly for a system of sewerage. For particulars address C. H. Kimball.

At Parkersburg, W. Va., it has been decided to issue $10,000 in bonds for sewers.

Mr. Robert Gage, of Mobile, Ala., has applied for a franchise for a sewerage system, and proposes to form a company to build it.

At Danville, Ind., $100,000 are to be expended on a sewerage system.

The Sewerage Committee, of Winona, Minn., has reported unfavorably on the Shone system on account of the expense, as it would have to be operated by steam power all through the year, both at high and low water.

At Brandon, Man., plans and estimates for a system of sewers has been invited. The population is about 4,000. For particulars, address the City Clerk.

**Street Work.**—The Warren-Scharf Asphalt Paving Co. has a contract for paving at Savannah, Ga.

At Paterson, N. J., there is a movement in favor of street paving and repair.

Trinidad asphalt is to be laid on De Rutte alley, at Buffalo, N. Y.

At Rochester, N. Y., the Council proposes to carry out considerable street improvement, including macadam, stone block and asphalt paving. For particulars, address Thos. J. Neville, City Clerk.

**Gasoline Lighting.**—At Sioux City, Ia., bids have been received for lighting the city streets with gasoline lamps. The Globe Light & Heat Co., of Chicago, offered to furnish 200 lamps at $19 per year each for a three-year contract, or $20 each for a four-year contract. The Sun Vapor Light Co., of Canton, O., proposed to maintain 300 lamps at $17 each per year for a three-year contract, or at $16.75 each on a five-year contract. The bids were referred to the Light Committee.

**Water Power.**—At Nephi, Utah, 3 water power plants have been laid out by Sturges & Bryant, engineers of Salt Lake City. The power will be used to generate electricity to operate machinery for grinding gypsum and for other purposes.

A number of capitalists of Seattle, Wash., and Minneapolis, Minn., headed by L. F. Menagie, of the latter city, are said to contemplate the building of a flume or tunnel from Lake Washington to the shores of Seattle harbor for the purpose of furnishing water power for manufacturing purposes. The level of Lake Washington is nearly 20 ft. above that of the bay at high tide, and the plan, as proposed at present, gives 18 ft. of fall, which is sufficient for all purposes, as it is proposed to put in a tunnel large enough to carry water in sufficient quantities for the needs of the largest factories. The scheme involves the outlay of a large sum of money.

## ELECTRICAL.

**Electric Lighting.**—At Fairhaven, Vt., it has been decided to have the streets lighted for one year at a cost of $1,500.

The Edison Electric Light Co. and the Gas Light Co., of New Bedford, Mass., have been consolidated.

The town of Uxbridge, Mass., has awarded the Uxbridge & Northbridge Electric Co. a 3 years' contract for lighting with 18 lights of 2,000 c. p. at $70 per light per year.

At Mauch Chunk, Pa., it has been decided to light the streets by electricity at $8 per light.

At Richmond, Va., the contract of the Schuyler Electric Lighting Co. will expire in September. The Council has passed a resolution directing the Committee on Electric Light and the City Engineer to report to the Council the estimated cost of an electric plant of sufficient capacity to light the city and to furnish electricity to private consumers. They will at the same time report the amount now paid for electric light on the streets; also the cost of the gas used for the same purpose

At Dyersburg, Tenn., Frank Shepard will put in an electric light plant, to be operated in connection with the water-works.

At Savannah, Ga., a contract for 50 additional lamps has been made with the Brush Electric Light Co.

The Thomson-Houston Electric Co. will put in an arc and incandescent plant at Tecumseh, Mich. The city's contract is for 20 arc lights for 5 years.

The Kakabeka Falls Electric Light Co., of Toronto, Ont., has been organized by A. P. Boller, of New York; E. D. Smith, of Philadelphia, Pa., and W. P. Douglas, of Minneapolis, Minn.

## BRIDGES, TUNNELS AND CANALS.

**Bridges**—*Holyoke, Mass.*—The following bids have been received for the construction of a plate girder bridge at this place:

| | |
|---|---|
| Berlin Bridge Co. | $24,767 |
| B. F. Hawkins Iron Works | 24,892 |
| Pittsburg Bridge Co. | 25,370 |
| Dean & Westbrook | 26,310 |
| J. E. Buddington | 26,440 |
| Wrought Iron Bridge Co. | 27,750 |
| Groton Bridge Co. | 28,000 |
| King Bridge Co. | 32,250 |
| Boston Bridge Works. | 33,050 |
| Penn Bridge Co. | 34,080 |

The contract was not awarded.

*Flushing, N. Y.*—The Long Island R.R. Co. contemplates the construction of a double track iron bridge across Flushing Creek, on the Green Neck branch.

*Allegheny Co., Pa.*—The county authorities have advertised for proposals for the superstructure and masonry of nine new bridges. These will be located as follows: Over Montour run at Schaffer's; Tom's Run at Dixmont; Poketos Creek at Dougherty's mill; Big Sewickley at Bradford's; Montour Run at the Beaver road crossing; Robinson's Run at Willow Grove; Flaugherty's Run, Burns' Run at Gumbert's and over the back channel of the Ohio River at Neville Island.

*Norfolk, Va.*—The contract for a counter-balance pivot bridge at this place has been awarded to the American Bridge & Iron Company, of Roanoke, Va.

*Waynesboro, Va.*—Proposals will be received for the construction of a double tracked iron bridge over the James River between the Baker Spring addition and the property of the Waynesboro Land Co. as soon as plans can be prepared.

*Wheeling, W. Va.*—The City Council has ratified an ordinance authorizing a loan of $100,000 for the erection of a bridge across Wheeling Creek.

*Norfolk & Southern R. R.*—The American Bridge Co., of Roanoke, has received the contract to build three drawbridges for the Norfolk & Southern R. R. between Norfolk, Va., and Edonton, N. C.

*Jackson, Miss.*—The Board of Supervisors have let the contract to build the approaches to Pearl river bridge to the King Iron Bridge Co., of Cleveland, for $10,800. This company built the iron bridge over the river. The approach will also be of iron.

*Newport, Ky.*—The contract for the new bridge at this place has been awarded to the King Bridge Co., of Cleveland, O. The structure is to be completed by Jan. 1, 1891.

*Pulaski Co., Ark.*—The county has been authorized to construct a bridge across the Arkansas River at a cost of $250,000. Address Commissioners of Pulaski Co.

*Jefferson, Ore.*—Hoffman & Bates have been awarded the contract for building the bridge at Jefferson, for $11,800 complete. The structure is to be a single span of 352 ft., two spans of 51 ft. each and nearly 500 ft. of approaches. The bridge is to be completed by Oct. 1.

## CONTRACTING.

**Dike.**—The following proposals for constructing a pile and stone dike in the Delaware River, at Kinkora Bar, were received April 17, 1890, by Major C. W. Raymond, U. S. Engineer Office, Philadelphia, Pa. The bid of Wm. T. Gaynor was recommended for acceptance.

| Bidders. | Approximate Quantities. Delaware Pine Piles 17,500 lin. ft. | White Oak Piles 500 lin. ft. | Pine Wales and Angle Blocks 45,000 ft. B. M. | Wrought Iron Tie Rods and Screw Bolts with Washers, 10,500 lbs. | Drift Bolts 1,000 lbs. | Stone Filling 3,600 cu. yds. | Total. |
|---|---|---|---|---|---|---|---|
| | Per lin. ft. | Per lin. ft. | Per 1,000 ft. b. m. | Per lb. | Per lb. | Per cu. yd. | |
| William Henry Lownsbury, Philadelphia, Pa. | 13½ cts. | 26½ cts. | $46.00 | 4½ cts. | 3½ cts. | $1.62 | $10,920.40 |
| Davis & Irvin, Philadelphia, Pa. | 15 " | 25 " | 37.00 | 3½ " | 3 " | 1.37½ | 9,7 7.50 |
| Ira Lunt, New Castle, Del. | 17 " | 27 " | 37.75 | 4 " | 3¾ " | 1.40 | 10,322.45 |
| William T. Gaynor, Fayetteville, N. Y. | 14 " | 23 " | 33.50 | 3 " | 3 " | 1.27 | 9,003.30 |
| Joseph S. Allen, Philadelphia, Pa. | 17 " | 30 " | 38.00 | 4 " | 3½ " | 1.50 | 11,632.00 |

**Public Buildings.**—The County Commissioners at Claude, Tex., and Spartanburgh, S. C., will build court houses at those places.

Plans and specifications are wanted for a brick, stone and iron courthouse in Orlando, Fla. Architects and builders are requested to communicate with Messrs. Chas. E. Ferguson and C. E. Smith, Orlando, Fla., committee of the Board of County Commissioners of Orange County, for information as to size and general character of building. Plans and specifications to be submitted by June, 1890.

At Colfax, Wash., the contract for cells for the county jail has been let to the Pauly Jail Mfg. Co. of St. Louis, Mo., for $12,500. A contract was let to Mr. White to complete the court house for $30,000, making the total contracts let to date for the court house and jail $95,000, the whole to be completed by August.

A jail will be built at Reidsville, N. C., by the County Commissioners.

Steel cages are to be fitted in the city jail at Fort Dodge, Ia.

**Street Work.**—The Contracting Board, Troy, N. Y., awarded contracts, April 15, as follows for brick sewers and tile connections: E. Broderick & Son, $3.90 for sewer and 60 cents for connections; $3.56 and 60 cents; $3.94 and 60 cents. Michael Anderson, $3.80 and 50 cents; $3.50 and 50 cents. C. Behan & Son, $3.43 and 65 cents. On April 19 the following contracts were awarded: Michael Anderson, $5.20 per ft. for sewer and 60 cents per ft. for laterals. Joseph Cavanaugh, $3.93 and 59 cents; $3.80 and 59 cents; $3.95 and 59 cents. Crowley & Gambell, $3.97 and 70 cents. C. Behan & Son, $3.40 and 60 cents.

The Superintendent of Streets, Brockton, Mass., has awarded the contract for block paving to Samuel Dillingham & Co., of Boston, at 25 cts. per yd.; and for setting edgestones to A. W. Keene, of Brockton, at 5 cts. per lin. ft. The other bidders for paving were as follows: P. Brennan & Co., Boston, 18 cts. per yd.; J. A. Colson, Boston, 20 cts.; D. Cram & Co., Boston, 20 cts.; G.W. Rhodes, Goodwin Mills, Me., 25 cts.; John Shay, Valley Falls, R. I., 43 cts.; F. Gore & Co., Boston, 25 cts.; O'Hare & Doherty, Boston, 19 cts.; H. Gore & Co., Boston, 25 cts.

The only bid received by the Street Committee, West End, Ga., for paving, was from Venables & Bro., of Atlanta, at $1.75 per sq. yd.; the bid was not accepted. It is probable that the material adopted will be 4-in. granite blocks flushed with cement.

**Sewers.**—The contract for 5,190 ft. of 8 and 10-in. sewer has been awarded by the Sewer Commissioners, New London, Conn., to A. Bach, of South Norwalk, at $5,244.65.

At St. Paul, Minn., a sewer contract has been awarded to Patrick Doherty at $4,487.

**Brick Paving.**—The contract for brick paving at Moundsville, W. Va., has been awarded by L. G. Brock, City Clerk, to Boren & Rosser, of Bellaire, O., at $1.05 per sq. yd. complete, including excavation, foundation and paving, without tar. The other bids were $1.10½, $1.12, $1.15, $1.17½ and $1.35 per sq. yd. The roadbed is to be rolled with a 7-ton roller and covered with 8 ins. of gravel and 2 ins. of sand. The paving is to be of hard burned fire-brick; the joints will be filled with sand. The paving will be rammed with 40-lb. rammers and rolled with the road roller.

**Piles.**—The Board of Docks, New York City, has received the following proposals for furnishing 400 piles: C. N. Kimpland, $19.80 per pile; A. J. Murray, $20. The contract was awarded to C. N. Kimpland.

**Stone.**—The contract for stone for paving has been awarded by the Council, Macon, Ga., to the Quincy Granite Co., of Macon, at 35 cts. per lin. ft.

The Board of Docks, New York City, has awarded a contract to Brown & Fleming at 94 cts. per cu. yd. for cobble-stone, and 62½ cts. per cu. yd. for rip-rap.

**Pier.**—Benjamin Van Brunt, of Seabright, N. J., has a contract for a pier and landing for Mr. Geo. F. Baker, at Monmouth Beach; it will be 300 ft. long and 8 ft. wide.

## PROPOSALS OPEN.

**Railway Buildings.**—Car shops, roundhouses, etc., at Tacoma, Wash.; to cost $800,000. The Northern Pacific R. R. Co., St. Paul, Minn.

**Sewers.**—Building sewers; 2,630 ft. of 30-in. pipe, 9,420 ft. of 24-in., 3,000 ft. of 20-in., 420 ft. of 12-in., and 874 ft. of 8-in.; 12 catch basins, 30 manholes, 1 flush tank, 280 ft. of 24-in. cast-iron pipe for river crossing. W. H. Goodhue, Milwaukee, Wis., Consulting Engineer. J. J. Hughes, Village Clerk, Waukesha, Wis. April 29.

**Pipe Laying.**—Laying about 8 miles of 4, 6, 8 and 10-in. cast-iron water-pipe. F. L. Fuller, Boston, Engineer. The Water Commissioners, Marblehead, Mass. April 29.

**Sewers and Street Work.**—The Contracting Board, Troy, N. Y. April 29.

**Court House.**—Completing building of brick or stone. David Frank, County Clerk, Conejos, Col. April 30.

**Pumping Plant.**—Erecting an engine-house and impounding reservoir, furnishing pumping engines and boilers, cast and wrought-iron piping, special castings, fittings, valves, lead, jute, and for excavation and performing the work necessary to complete the pumping station on the Hot Springs Reservation, at Hot Springs, Ark. Hon. John W. Noble, Secretary of the Interior, Washington, D. C. April 30.

**Street Work.**—Asphalt paving and granite block paving; on concrete foundation. The Commissioner of Public Works, 31 Chambers St., New York City. April 30.

**Pipe.**—Furnishing water pipe, as follows: 50 tons of 4-in. class B, 30 tons of 4-in. C, 270 tons and 320 tons of 6-in. B. and C, 20 and 25 tons of 8-in. B and C, 125 and 60 tons of 12-in. B and C; also, 200 tons of special castings. E. N. Bigelow, Chief of Department of Public Works, Pittsburg, Pa., May 2.

**Electric Light Plant.**—Plans and specifications on file. Roddey & Whitner, Anderson, S. C. May 7.

**Scows.**—Building 2 dump scows. Major D. W. Lockwood, U. S. Engineer Office, Cincinnati, O. May 10.

**Steam Plant.**—Steam engine, boilers, etc., for gun factory. Lieut.-Col. F. H. Parker, Ordnance Department, West Troy, N. Y. May 10.

**Water-Works.**—Plans and estimates for works suitable for a population of 4,000; $500 paid for those accepted. The City Council, Brandon, Man., Canada. May 15.

**Sewer.**—About 4,000 ft. of brick and 2,500 ft. of pipe. Dr. H. E. Beach, Clarksville, Tenn. May 19.

**Sewers.**—Sewers and plumbing. The Post Quartermaster, Fort Supply, I. T. May 19.

**Sidewalks.**—About 65,000 sq. ft. at Fort Sheridan, Ill. C. P. Miller, A. Q. M., U. S. A., Highland Park, Ill. May 22.

**Well.**—Boring artesian well, 2,500 ft. deep, 6 ins. diameter at the bottom. Henry Sayles, President, Artesian Well Co., Abilene, Tex. June 2.

**Court House.**—Rebuilding court house at Quitman. A. H. Johnson, Architect. John Tillman, Chairman of Board of County Commissioners, Quitman, Ga. June 10

## MANUFACTURING AND TECHNICAL.

**Locomotives.**—The Railway Equipment Co., of New York, has an order for 200 freight locomotives for the New York Central. They will represent an investment of about $2,000,000. The lighter engines on the road, it is said, will be sold to other companies. A good market for these smaller second-hand engines is generally found in the South.

The Rhode Island Locomotive Works, of Providence, R. I., have an order for 5 mogul freight engines for the Columbus & Hocking Valley.

The Pittsburg Locomotive Works, of Pittsburg, Pa., have an order for 17 engines for the Wheeling & Lake Erie.

The Baldwin Locomotive Works, of Philadelphia, Pa. have built two consolidation engines for the Central New England & Western. Also 16 ten-wheel fast freight engines for the Philadelphia & Reading; cylinders, 20 × 24 ins.; driving wheels, 60 ins. diam.; boiler barrel, 64 ins. diam.; Wootton fire boxes. They are building 48 engines for the Denver & Rio Grande.

The Cleveland, Cincinnati, Chicago & St. Louis has ordered 10 ten-wheel passenger engines. As soon as they are received the 5 Schenectady engines, purchased 2 years ago, will all be transferred to the Kankakee end of the line. They are as large a passenger engine as can now be run on that division. When these engines were purchased they were among the largest in the West, but the tendency is still to larger and more powerful passenger engines.

Three of the Class "S" freight locomotives have been received for service on the eastern division of the Chicago, St. Louis & Pittsburg. These have been placed on the Columbus end; the others will be put in service on the Indianapolis end of the line. The weight on the drivers of this class of engines is 94,200 lbs.

The Pulaski St. Ry. Co. will purchase a dummy engine. For particulars address L. S. Calfee, Pulaski City, Va.

**Cars.**—The Basic City Car Works Co. has been organized at Basic City, Va., by W. S. Gooch, of Roanoke, President; James Bumgardner, of Staunton, Vice-President; M. A. Booker, of Staunton, Secretary and Treasurer. Capital stock, $50,000.

The Mount Vernon Car Mfg. Co., of Mount Vernon, Ind., has been organized by D. O. Settlewire, President; W. C. Arthurs, Secretary and Treasurer; S. M. Grubbs, S. T. Stratton, John C. Lueckel and Frank Snyder, all of Litchfield, Ill. Mr. Snyder will be Superintendent of the works.

The Ohio Falls Car Works, of Jeffersonville, Ind., have been awarded the contract for building 3 complete passenger trains for the Columbus, Shawnee & Hocking.

The Indianapolis Car Works, of Indianapolis, Ind., have bid on 1,000 box cars for the Chicago, St. Paul & Kansas City.

The Lehigh Valley is building 10 new parlor cars at the South Easton shops. They are 60 ft. long, being 10 ft. longer than those now in use, and have a seating capacity of 27 chairs. A smoking compartment large enough for 10 occupies one end of the car. For invalids a divan is provided which can be concealed by curtains if necessary. The interiors are finished in antique oak. The cars will cost $10,000 each.

The Pulaski St. Ry. Co. will purchase cars and entire equipment for its dummy railroad. For particulars address L. S. Calfee, Pulaski City, Va.

The Barboursville Land & Improvement Co., of Barboursville, Ky., will purchase rolling stock for a street railway, and also cars for hauling coal, etc.

**Street Cars.**—The Tripp Mfg. Co., of Boston, is building a double truck car for the West End St. Ry. Co., of Boston. The car will have 8 wheels, will be 28 ft. long from door to door, 7 ft. 3 ins. wide, and 7 ft. 9 ins. in height from the floor, and will have a seating capacity for 40 passengers. Each truck has four 30-in. steel wheels, and two 15 h. p. Thomson-Houston motors. The car will be provided with vacuum and hand brakes, and the brakes will be operated by a toggle joint arrangement giving great power. The Tripp patent roller bearings will be used throughout, and the car will be hung on trucks of an entirely new design (on which patents are pending), the equalizing bar being connected direct to the journal boxes underneath, instead of passing around on top as hitherto. There are said to be less parts and fewer bolts about the new Tripp truck than on any other form of truck, and they leave plenty of room for the application of the motors and electrical apparatus.

The Pullman Palace Car Co., of Chicago, Ill., is doing considerable work in building street cars. A large number of open and closed motor cars for electric lines have recently been ordered.

The Lewis & Fowler Mfg. Co., of Brooklyn, N. Y., has orders for 50 open cars, seating 35 passengers, for the Eighth Ave. Ry., of New York City, and 80 open cars, seating 40 passengers, for the Brooklyn City Ry., of Brooklyn, N. Y.

J. G. Brill & Co., of Philadelphia, Pa., have an order for 200 cars for the Lindell Ry., of St. Louis, Mo.

The Robinson & Moan Car Co., of Minneapolis, Minn., has several orders on hand for street cars.

**Car Lighting.**—The Boston & Albany R. R. is said to have adopted the Pintsch compressed gas system of lighting for its cars.

**Track Improvements.**—Mr. Goldie, of Dilworth, Porter & Co., Pittsburg, Pa., inventor of the Goldie spike, has taken out patents for a spike brace and a tie-plate. He has also invented a device which is fitted to a hand car and indicates irregularities in the track.

**Railway Gates.**—The Mills Railroad Gate Co., of Chicago, is making three styles of gates, worked by air, lever and cable. This company's gates are in use on the Northern Pacific, Wisconsin Central and Chicago & Northwestern, and other roads.

**Road Roller.**—The Salt Lake City (Utah) Corporation, Mr. Geo. M. Scott, Mayor, has ordered a 10-ton Aveling & Porter steam road roller, through the Utah & Montana Machine Co., of Salt Lake City. Mr. W. Oastler, of New York, is the agent for these English machines.

**The Canton Wrought Iron Bridge Co.**, of Canton, O., sends us two of the handsomest photo-gravures of bridges we have yet seen. One represents the bridge over the Mississippi River, at Minneapolis, Minn. This bridge, built in 1888, has two arches of 456 ft. span, c. to c. of end hinges, with a versed sine of 90 ft. Including approaches the bridge is 1,273 ft. long; the roadway is 18 ft. wide, with two 6 ft. footways in addition. The arch is 29 ft. wide and the total weight is 1,000 tons. The other bridge is a three-hinged arch of 216 ft. span and 27 ft. versed sine; with a 16-ft. roadway and two 5-ft. footways. It crosses the Salmon River at Pulaski, N. Y., and was built in 1888. Both bridges were built by the Canton Bridge Co.

An Iron Curbing has been patented by Mr. Israel L. Landis, of Lancaster City, Pa. It is a vertical iron or steel plate, with or without an angle at the top, anchored back under the pavement by a rod passing through the plate. It is recommended as costing half the price of stone for this purpose, and in western countries where stone is scarce should do good service. It will remain straight, requires no trench digging to place it, cannot be chipped and is neat in appearance. Any further inquiries should be addressed to the inventor at the town above named.

**Tramways.**—The Ocmulgee Brick Co., of Americus, Ga., desires to correspond with manufacturing company as to the quickest and cheapest method of hauling clay from yard to mill, a distance of ½ mile. Track is laid. Address P. C. Clegg, president.

A tramway 2½ miles long to the Booker ore mine is projected by the East Broad Top R. R. Co. For particulars address Mr. A. E. Bachert, Engineer, Orbisonia, Pa.

**Car Wheel Works.**—Plans and specifications for the construction of the new works of the Pennsylvania Rolled-Steel Car Wheel Co., which are to be erected near Norristown, Pa., have been agreed upon, and provide for the erection of two open-hearth furnaces and the placing of the rolling machines in such a position that they can be advantageously operated in connection with the furnaces. A contract for a 1,500 H. P. engine has been awarded to Wm. Tod & Co., of Youngstown, O.

**Sewer Pipe.**—The Knoxville Stoneware, Sewer Pipe & Tile Co. has been incorporated at Knoxville, Tenn. President, W. M. Swaney; Secretary, D. H. Steward. Capital stock $30,000.

**Compressed Air Motor.**—The National Compressed Air Motor Co., of Kansas City, Kan., has been organized by C. F. Buckhalter, F. C. Nally, L. Lindsay, Geo. J. McCarben and P. C. Broll, of Kansas City, Kan. Capital, $100,000.

**Turntables.**—The Cincinnati Southern R. R. Co. has placed an order with the Ross-Meehan Brake Shoe Foundry for a pair of turntables upon a patent that it owns. The tables are round, consisting of a bottom and upper casting. The lower casting is permanently fixed into a socket, and around a groove almost at the edge of the plate there are 37 cast-iron balls. The upper plate is constructed similar to the lower one, and the balls fit into a corresponding groove, allowing space between the two edges so that the table can work easily. The table weighs over 5 tons, and one man can work it with a load of 15 tons upon it.

**Brake Gear.**—The Higham Brake Adjuster Co., of East St. Louis, Ill., has been incorporated by C. C. Higham, S. M. Dodd and Albert Blair. Capital stock, $100,000. The company will make and sell devices for taking up the slack motion in brake rigging and other mechanisms.

**Fire Boat.**—The City Council of Seattle, Wash., has awarded the contract for the fire boat to the Seattle Dry Dock & Shipbuilding Co., for $38,475, and for the fire pumps for the same to the Clapp & Jones Fire Engine Co., of Cincinnati, O., for $11,000, making the total cost of the boat $49,475.

**Pumps.**—The new pumping plant for the Gold Hill combination, at Virginia City, Nev., will consist of three pumps that will lift daily 1,250,000 galls. from a depth of 800 ft.

**Tube Works.**—The Kellogg Seamless Tube Co., of Pittsburg, Pa., will build works very soon.

**The Barber Asphalt Co.**, of New York, will start a plant in Lockport, N. Y., and has appointed C. N. Stainthrope & Co. agents. It has been decided to build the works on the State road. Excavations will be begun immediately and the machinery is expected soon.

**The American Well Works**, of Aurora, Ill., have opened a branch house at 1113 Elm St., Dallas, Tex., where they will keep a stock of supplies and standard machines to supply their large and increasing Southern trade.

**Metal Market Prices.**—*Rails.*—New York, $33 to $34; old rails, $23.50 to $24 for iron, $21.50 for steel. Chicago: $35; old rails, $22.50 to $23 for iron, $19 to $20.50 for steel. Pittsburg: $32.50 to $33.50; old rails, $23.50 to $24 for iron, $21 to $21.50 for steel.

*Track Materials.*—New York: steel angle bars, 1.75 to 1.90 cts.; spikes, 2.10 to 2.15 cts.; track bolts, 2.9 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.10, or 2.20 cts. delivered at Chicago or St. Louis; track bolts, 2.90 to 3 cts., with square, and 2.95 to 3.10 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.25 cts. for steel, and 1.92 cts. for iron; spikes, 2.05 to 2.10 cts.; track bolts, 2.65 to 2.70 cts. with square, and 2.75 to 2.80 cts. with hexagon nuts.

*Pipe.*—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

*Lead.*—New York, 3.85 to 3.95 cts.; Chicago, 3.75 cts.; St. Louis, 3.75 cts.

*Structural Materials.*—Pittsburg: angles, 2.10 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plates, 2.40 cts.; refined bars, 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.90 cts. for tank.

**Pumps.**—T. Pearson & Sons, contractors on the Hudson River tunnel, have bought a new Pulsometer pump to remove the water let in by the recent break in the shaft.